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Popular Science Monthly for October, 1930

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Eight Investments In One

How the Investment Trust Taps Eight Sources Of Profit for the Small or Large Investor

BRAXTON checked the column of figures once more, picked up the report and walked into Morgan's office. Both men held responsible positions in The City Contracting Corporation, and were close friends, primarily by virtue of being neighbors at home.

Ralph Morgan was just finishing a telephone conversation as Braxton came into the little office.

"Yes, Knowles. I received your literature, and from what I can make out the preferred stock does look like a good buy now. . . no I haven't, but you'll hear from me shortly. . . all right, good-bye."

"Well Ralph, what are you buying now?"

"Oh, just thinking about buying some more Investment Trust preferred stocks," his friend replied.

"Investment Trust? Say, tell me about it, won't you? I've heard a lot about Investment Trusts lately. What do Investment Trusts offer that makes them attractive?"

"All right. I'll tell you. Generally speaking there are about six different types of investment trusts. The one I have in mind is known as 'The General Management Investment Trust.' Here tremendous importance is placed upon management, because this type of trust can change its holdings at will. An A-1 Management Trust will always reveal at its directing helm, men of proven ability, men whose records are absolutely unimpeachable. And while these men are responsible to a Board of Directors, consisting of financial leaders throughout the banking and industrial centers of the country, in their hands lies the power of buying and selling the securities which the Trust holds. The Management Type of Trust never holds more than a small proportion of any one company's securities. Its holdings, represent a wide diversity of securities, thereby maintaining a position that enables the Trust to quickly turn over certain securities and buy others when such a policy seems advisable. Also this type of Trust can invest its money in call loans, and never buys securities on margin or sells short. So much for the trust in question.

"Now for the next point—'Why is their stock attractive?' At present the preferred (no par) is selling at about $40 a share—and since they pay a $3.00 annual dividend, if you bought now, you would be getting 7½% for your money. What's more, if this investment trust were to liquidate its holdings right now—each share of preferred stock would be worth close to $60.00."

"How is that possible?" interrupted Braxton.

"Well, it wouldn't be possible in a really normal market, where true values determined the stock prices. But now, due to conditions in general, and due to the fact that investment trust securities have not recovered their justified strength, undermined by the near panic in November—almost all of them are in the same peculiar situation of being available at prices below their liquidating values."

"That certainly sounds interesting, Ralph. But now tell me why investment trusts of the General Management Type can do more for the individual investor than he can for himself. According to modern business principles—the jobber is being displaced along many lines by 'direct-to-the-consumer' methods. There you have an elimination of one step that benefits the ultimate purchaser greatly. Evidently, though, this doesn't hold true for investment trusts."

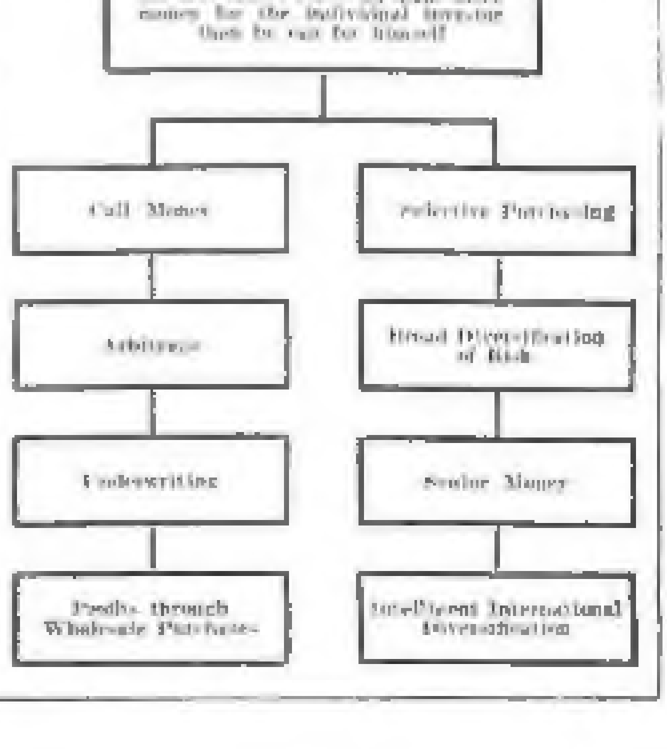
"No, it doesn't" Morgan replied. "Here you have exactly the reverse condition. The individual buys Investment Trust Stock and thereby becomes a pro-rata share holder in the securities which that Trust holds."

"But can't he buy those same stocks himself and save the intermediate cost?"

"He can, but there are factors designed to benefit him much more through purchasing investment trust securities."

"I still don't see why," Braxton asked.

"Well," Morgan began, and then changing his mind, opened a desk drawer and pulled out a piece of paper. "Here," he said, "is a chart showing eight specific ways which place an investment trust of this type in a position to make more money for the individual investor than he can for himself." Braxton read the chart very carefully. (Continued on page 6)



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Eight Investments in One

(Continued from page 4)

"That's all very pretty, Ralph, but I know no more about it now, than you know about sun worship among the Aztecs, assuming that you don't know anything about that."

"I don't, Charlie. Maybe the chart does need a little explaining. Let's see:

"Number One is Call Money—which as you know is money loaned by banks to brokerage houses for covering stock purchases. The interest charges may vary from under 1%, to over 20%. Since the minimum amount accepted by banks is usually $100,000, there are few individuals who can put their money out on call. Certainly you can't."

"Guess not," smiled Braxton.

"Neither can I, or any average individual investor," continued Morgan. "Of course an investor might club together with a number of friends and raise that amount. But then they could not take advantage of another consideration. The call rate in New York may be 5% and in Tokio it may be 10% at the same time. The investor couldn't know that. Even if he did, he would have no way of putting his money on call in Tokio. Whereas the investment trust can tell its New York Bank to communicate with its Tokio Correspondents and have them place a lump sum on call in that city, thereby gaining a 5% difference in interest right there."

"That point is clear enough, but where does the trust get all this extra money to play with?"

"Not all of their funds are in securities at any one time. There is always a cash reserve, some of which is used for just such a purpose as call loans, if it is advantageous to do so."

"All right Ralph, next is Arbitrage. What is the name of finance is that?"

"Arbitrage is the simultaneous buying and selling of securities in different markets—for the purpose of profiting by the difference in price that may be prevalent in such markets. In other words, suppose an investment trust learns that a certain stock can be sold for 60 on the Chicago Stock Exchange. Inquiry in New York reveals the fact that it can be bought on Wall Street for 58. Simultaneous orders for buying and selling will then reward the investment trust with a two point profit and an immediate turnover. I have been told that one investment trust made its entire year's dividend on just such a transaction, without in any way changing its investment position. The average investor is not in a position to do this. He cannot have the necessary facilities for operating on the different exchanges at the same time."

"Clear enough, Ralph. Proceed."

"Next is the question of underwriting. Practically every sound trust in the country today, with proper connections, can join underwriting syndicates who intend to finance new companies or new enterprises which offer proof of success, and subsequent profits for the underwriters. Again the lack of adequate funds stops the average investor, who ordinarily has his hands full in securing enough money to subscribe to a small block of securities, let alone finance a whole issue!

"Number Five is Wholesale Purchasing. Here the Investment Trust through the influential connection of its Management and Board of Directors is in a position to realize immediate profits by buying from banking houses new issues, such as standard bonds, etc.—if they so desire—at wholesale prices. In many instances, investment trusts are approached before the issue is open to the public, and if they do buy, the transaction involved often raises the price of the issue when it is released to the general market."

"That seems reasonable. Now, next is Selective Purchasing."

"That is simply the close, thorough and expert examination of hundreds of securities both here and abroad, for the purpose of selecting the most attractive values obtainable. Obviously, the individual is once more handicapped by lack of knowledge and funds—whereas the investment trust under efficient management can call upon its complete staff of statisticians and economists for an analysis of any contemplated purchase—and, of course, act accordingly.

"Number Six is Broad Diversification of Risk. If you have $5,000 to invest, you'd be doing well by spreading that money over a dozen different securities. But if you put that amount or any sum, for that matter, into Investment Trust Securities you will hold pro-rata, as I do, a certain share of each of the 200 or more diversified investments, both domestic and foreign, which make up the holdings of this trust. Is that clear?"

"Rather, what next?"

"Senior Money—by which is meant the funds obtained by the trust through the sales of its own bonds. On these they pay around 5 or 6%. According to the statement of a leading industrial banker, well managed, soundly organized Investment Trusts should have no difficulty under normal conditions in earning from 10 to 15% on that money. Naturally the holder of trust securities shares in the profits, obtained by the difference in these two sets of interest rates. The Investment Trust can do this—the individual investor can not.

"Last is the matter of Intelligent International Diversification. It is generally acknowledged today that the wise investor should hold some international securities. In every financial center of the world, in Hamburg, Berlin, Stockholm, Brussels, London and Paris, issues of exceptionally attractive values are constantly being offered. But how is the individual to determine the good from the bad, how is he to act upon this judgment? He cannot. For, again he is hampered by lack of information and sometimes, resources. Yet, by purchasing Investment Trust Securities he becomes a part holder in the finest international issues available. The well managed trust, through its banking connections all over the world has access to the most reliable *(Continued on page 7)*

Eight Investments In One

(Continued from page 6)

sources of information, and through its strong financial position, can take advantage of a good buy when it appears.

"Well, Charlie, that's the story as I understand it. A good Investment Trust, in any case, can always do as well as the individual investor. Under normal circumstances, I have shown you eight ways in which a General Management Trust can make more money for the individual than he can for himself."

"What you say certainly sounds convincing, Ralph. When I have money to invest I'll certainly keep in mind what you've told me."

* * * * *

Note: The telephone conversation between Morgan and his broker took place on July 24th. At that time all soundly organized investment trusts offered exceptionally fine values. Not having yet recovered from the successive crashes in November, 1929, and June of this year, they were still selling below their liquidating values. Of course it is impossible to forecast the future position they will hold with respect to the rest of the market—but it does appear safe to say that when this article appears, investment trusts will still be offering opportunities worth careful consideration.

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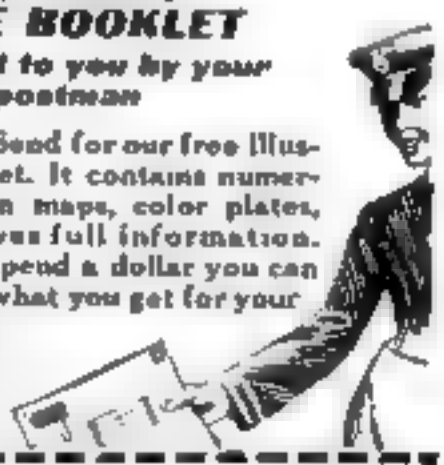

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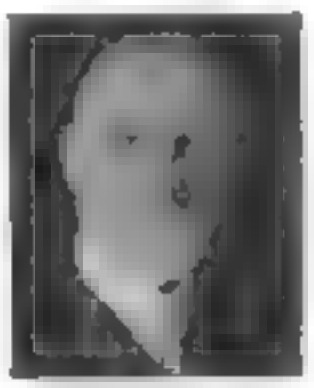

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A COACH MODELING CONTEST *is announced*

The entrants in this contest will compete for awards on the basis of their craftsmanship in fashioning a model of the Napoleonic coaches.

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Watch future issues of this magazine for further comment and news of the Guild.

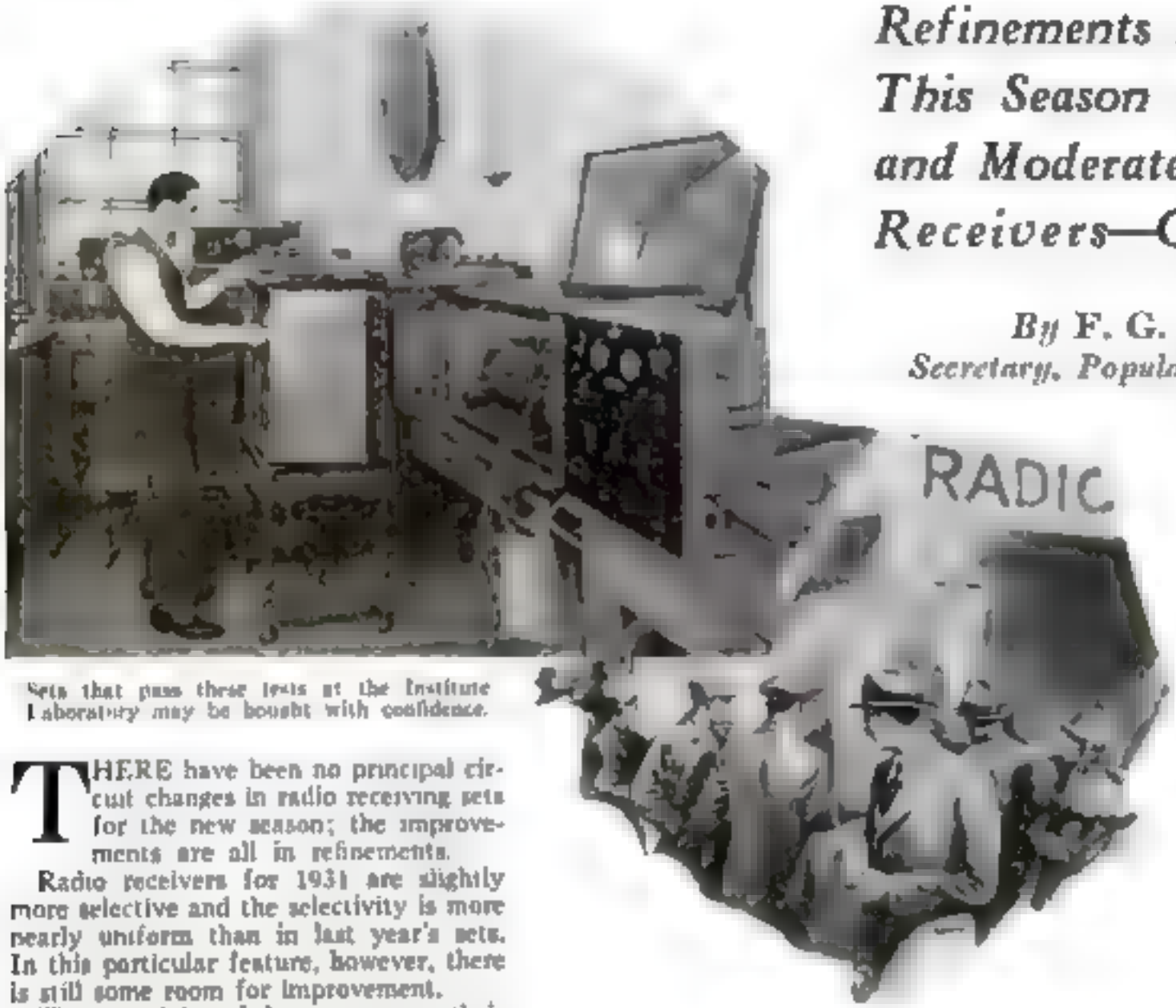
FISHER BODY CRAFTSMAN'S GUILD

Sponsored by **FISHER BODY CORPORATION, DETROIT** *Division of General Motors*

Where the New 1931 Sets Differ

Refinements Are Available This Season in Both High and Moderate Priced Radio Receivers—Cabinets Better

By F. G. PRYOR
Secretary, Popular Science Institute



Sets that pass these tests at the Institute Laboratory may be bought with confidence.

THERE have been no principal circuit changes in radio receiving sets for the new season; the improvements are all in refinements.

Radio receivers for 1931 are slightly more selective and the selectivity is more nearly uniform than in last year's sets. In this particular feature, however, there is still some room for improvement.

The sensitivity of the new sets, or their ability to bring in distance reception, is more even and uniform than previously. The old sets frequently were sensative over one section of the dial, but on the longer wave lengths the sensitivity usually dropped considerably. The new receivers, on the other hand have a more even sensitivity over the entire wave band.

Now, more than ever before, there is no need of waiting for perfection. The fidelity of reproduction made available this year—and this is the feature that ninety percent of the radio buyers consider most important—has not exceeded the high degree of perfection attained last year. In fact, sets now are so faithful in their reproduction that manufacturers have had to put on a "tone control" to make them sound better to the average human ear which is not able to appreciate or care for a reproduction too nearly perfect. These tone controls, which are being used in more than fifty percent of the new sets, permit the user with an untrained ear to distort the tone quality to the point where it sounds best to him.

IN addition to these tone controls, there are many other accessories to be found on a number of the new receivers. Automatic volume control, a feature by which volume may be adjusted once and will remain constant or practically constant all the time, is found not only on many of the higher priced sets but also on a good many of those more moderately priced. Remote control is another feature that will be afforded by a number of sets, usually as an optional accessory

Cross-modulation, a defect that caused the POPULAR SCIENCE INSTITUTE to refuse approval to several radio sets two years ago and to quite a few last season, appears to be satisfactorily handled this year by various methods, a process called "preselection" being most frequently used to take care of this

A thing that will prove striking to the public is that, before the season is out, the super-heterodyne type of set will be available from several manufacturers whereas previously such sets were to be had from only one large company

Also, by the time the season gets under way, there are a number of manufacturers who will put out some extremely compact receivers. These small receivers are designed to fill a special need rather than replace the average set. In putting such sets on the market, manufacturers expect that their sale will be in households where it is desirable to have a second radio set in another part of the house to supplement the regular family receiver installed in the living room. These small sets are not up to the larger and more expensive ones in efficiency, of course, but they provide satisfactory reception and many people will want them installed upstairs, in the kitchen, or in some other part of the house where the regular set is not audible

As a general thing, there has been no attempt to cut down the size of the radio receivers made for ordinary purposes. Better cabinets are used today, there being a definite improvement in this respect. Cabinets seem to be one extreme or the other this year, the majority being made along very plain lines, though a few are a trifle ornate in appearance.

ON the whole, the radio receiving sets today are sturdier, need less servicing, and represent better value than ever before. While the average price level will remain the same as in the middle of last season (about $140), the buyer with only a small amount to spend can get a set this year that will suit normal requirements, while others, with more to invest, will get greater returns for their money than was possible any season previous to this. Never before would an investment in a radio receiving set bring so much as it will at the present time.

POPULAR SCIENCE INSTITUTE has tested many of the new sets and will gladly supply readers with a list of those found up to 1931 standards of efficiency and value The Institute's tests are made in its well equipped laboratory at New York University, and the performance of the various sets is carefully measured. For the approved radio list, address POPULAR SCIENCE INSTITUTE, 381 Fourth Ave., New York, N. Y.

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Refrigeration for the Home*

House Heating and Ventilating*

Insulation in Building Construction*

List of Approved Tools

List of Approved Radio Equipment

List of Approved Oil Burners

Advice on Installing Oil Heat

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Montgomery Ward & Co., Retail Store, Denver, Colorado. Presdwood used for lining forms (Rocky Mountain Photo Co.)

Cincinnati Bell Telephone Bldg., 140,000 sq. ft. ¼" Presdwood used for lining concrete forms.

Ohio Bell Tel. Co., Dayton, Ohio, Interior showing slab, beam and column construction. Presdwood used to line slab forms.

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Our Readers Say

Same System Babe Ruth Uses

I READ Alex J Morrison's golf article in the September issue. That may be the way to do it—for Alex J. Morrison who seems, from his pictures, to be about the same length and heft as a fly rod. Me, I'm five foot eight, and tip the beam at 216 bathside. If I stood erect I couldn't see the ball. If I transferred my weight from hip to hip—well it can't be done, what I mean. Sorry, but I guess I'll just go along busting the ball on the nose.—T. L. C., Philadelphia, Pa.

In Other Words Can Nothing Lift Something?

THIS talk about the upper surface of an airplane wing producing most of the lift is just nonsense. It is a pretty theory and popular among flying instructors, but no professor of physics, after a scientific analysis, can give it credence. It is true that a partial vacuum is produced on the upper surface of a moving airplane wing, but strange as it may seem, this partial vacuum is still a pressure, since only a pure vacuum exerts no pressure whatsoever. Even then it could *lift* nothing because all the vacuum in the world could not lift a feather if there were no counteracting air pressure. The only place this counteracting pressure can do its work is beneath the wing, exerting its force upward. Since a partial vacuum is a pressure (10 lb. per sq. in. air *pressure* is a partial vacuum), it therefore cannot exert a *lift* on the upper surface.—M. J. K., Chicago, Ill.

"Phoney" Age Problem Stumps Him

THE NUMEROUS problems in the reader's column never interested me until the "phoney" one of L. D. L. last month. His problem as stated has two variables to satisfy one condition and therefore the boy's age is entirely dependent upon the age of his brother. The brother's age is not given and so the problem is ambiguous. I don't feel so brilliant, though, because of the hint POPULAR SCIENCE gave me in the heading for the article, "Use your wits instead of your pencil." W. R. may be interested to know that his thirty-two-inch umbrella will not quite fit the suitcase without being folded up or gouging a hole in the suitcase.—F. W. P., Park Ridge, Ill.

Fair-Minded but Likes Home Workshop

I CANNOT agree with W. L. L., Kynesville, Fla., when he asks you to publish more on aviation and less on building furniture. If I were justified in asking you to publish more Home Workshop, I should certainly do so, but I realize that if you favor any one department, the others obviously would have to be slighted. However I have been unable to find magazines dealing exclusively with home workshop projects, so perhaps my request would be a little more worthy of consideration than that of W. L. L. were I to make it. However, the only request I shall make is, please do not favor or slight any department and keep your magazine as interesting to all as it is now.—E. L. H., Owosso, Mich.

Aviation Leaves Him Cold

IT PLEASES me to learn "W. L. L." is getting so much kick out of your articles on aviation. By all means continue to print them for something of value to aviation will result. Although I am writing for myself I think I express the feeling of many situated as I am when I say that inasmuch as aviation is beyond my reach, as pilot, owner, or builder, I would be wasting time acquiring knowledge I will never have the opportunity to use. Evidently "W. L. L." does not realize there are many who find as much pleasure gaining knowledge of furniture making as he does from reading about aviation. But beyond the acquisition of knowledge, we who read about furniture making, do build what we read about.—W. L., Baton Rouge, La.

Is Life Too Easy? Most Don't Find It So

THE PAGES of your September issue raise a startling question in my mind. Don't you think that life is being made altogether too easy for mankind? I notice a new device that, on the turn of a key, raises a car on jacks; another where the mere weight of an auto opens and closes garage doors; a switch turns the radio on for you, an automatic camera takes your picture and you don't even have to pose. See what I mean? Everything is being done for everybody. Give us pre-digested food, and an automatic razor that shaves while you sleep, and man will be taken care of as completely as a new born babe. Is all this good for us? I wish you'd tell me.—S. A. G., Hartford, Conn.

Not Enough of Clark's Models

I THINK JUST as J. W. W., Jr. of Albany, N. Y., does about everything except magic. I don't give a hoot about that. Nevertheless I give a great big hoot about all sorts of model airplanes. I have built every model that Donald Clark has published and I especially like the Lockheed "Sirius." I was glad to see the plans for the DO-X in the July issue. I should think you should have two of Donald Clark's models in every issue.—R. B. W., Lowell, Mass.

Applied Chemistry Strenuously Demanded

R. H. B. OF PHILADELPHIA is right. Chemistry plays its part, and a very important part. If it were not for chemistry, POPULAR SCIENCE MONTHLY would not be able to print in its pages the wonderful achievements in aviation and radio. What does chemistry with its test tubes and crucibles have to do with an airplane? It is up to POPULAR SCIENCE MONTHLY to print a few articles on applied chemistry.—J. D. F., Carlisle, Pa.

Models His Hobby and He Calls for More

I HAVE BEEN a reader of your magazine for about two years, and during that time I have formed a hobby of building ship models, which Captain McCann made possible. So far I have finished the Spanish galleon, pirate galley, and Viking ship, 8-inch Baltimore clipper, and *Santa Maria*. The latest one the half-model of a barque I have just finished. All were made through your magazine and blue prints. Although I'm a big order I would like to suggest that Captain McCann give us the following ship models to make: Admiral Farragut's *Hartford*, steam and sail, a modern destroyer working model (if possible with working engine); an early American

sloop, and a whaling bark. I am now making the fishing schooner *Bluenose* as a show model, but intend to make a five- or six-foot model to sail in Central Park Lake.—C. B., New York City

Bus Drivers Just Aren't Like That

I HAVE JUST finished reading the article in the July issue about the bus lines of this country. At this moment I am wondering where the author received or inherited an imagination that enabled him to paint such an enviable Utopia as that depicted in his article, wherein amiable bus drivers slow their schedules during inclement weather and, in order to conform to a more or less hazy tradition stop to render service to becalmed motorists. In my several years of driving I have yet to see a bus driver go slow during bad weather, or in fact, in any weather. More than a few times I have witnessed the common case of a bus driver passing a car that was already traveling at the limit decreed by the law. Not, of course, that all bus drivers do such things, and probably, many of them *do* keep within the speed limit, but it is my opinion that in a magazine article averages should always be given, not extremes. As to the statement that drivers will stop to give aid to motorists—well, I personally, have never heard of one who did such a thing and I am inclined to believe that a considerable majority of the motorists of the country will agree.—A. C., Erie, Pa.

Want Plans for Express Cruiser Model?

IN *Our Readers Say* for July, O. M. S. wishes to construct a model of a modern express cruiser, preferably the sixty five-foot cruiser built by the C. L. B. B. Corporation of Chicago. The writer would like to see POPULAR SCIENCE MONTHLY publish plans for the building of such a model.—J. W. F., Oakland, Calif.

Magic Squares Are Made to Order

THE PUZZLE of A. H., Brooklyn, N.Y., is solved by making two magic squares one with numbers 1 to 9, the other with numbers 10 to 18.

4	9	2
3	5	7
8	1	6

13	18	11
12	14	16
17	10	15

These combinations are arranged in the circle as shown in the illustration. An easy way to make magic squares with an odd number of figures which any one can understand and which will hold good for larger squares, is to make a diamond of squares as in the lower part of illustration, writing in the numbers 1 to 9. Then transfer to blank squares within the central one the numbers 1, 3, 9, 7, to the inner square farthest opposite.—A. L. S., Mildred, Pa.

Just for the Sake of Being Really Accurate

P. L. OF NEWARK, in his explanation of R. W. H.'s gravity question, should be a little more explicit and perhaps a little more nearly correct. A body falling into the earth's atmosphere approaches the earth at an acceleration depending on its distance from the earth. It continues to fall with increasing speed as it approaches the earth until the air resistance overcomes its falling momentum. It then does not descend at a constant rate of speed but continues to fall at a speed which is a function of varying influences, the most important of which are increasing air force as atmospheric pressure increases, increasing gravitational forces as it nears the earth, and increasing resistance as the body expands by frictional heat.—G. A. W., Springfield, Mass.

All Right, Then, We'll Keep It Going

WERE YOU to discontinue publishing *Our Readers Say*, I know of one reader you would lose. I read these pages before I do any other in your magazine. Yours for more *Our Readers Say*.—L. W., Lafayette, La.

Did You Guess They Were Twins?

IN THE JULY number of POPULAR SCIENCE MONTHLY appears this problem: A boy being asked his age replied: "I am now three times older than my brother's age nine years ago." How old is the boy? I find that the boy is thirteen and a half. His brother being four and a half nine years ago is also now thirteen and a half. The boys, of course, are twins. Does the author of the problem agree with me?—L. E. A., Ridgeway, Pa.

Can You Say as Much for Your Boys?

HAVING charge of the manual training of forty-six boys of all ages, I am taking advantage of this opportunity to tell you that we have constructed nearly everything that has been printed in your magazine for the past five years.—W. E. M., Cleveland, Ohio.

H. H.'s Monorail Hits the Bumps

I MAY BE a little late, but I feel that I must answer H. H., of Mattoon, Ill., who in the May issue, said that in his opinion airplanes never would be a safe means of transportation and illustrated his point by describing a monorail train and its dangers. He seems to forget the common rules of science in his explanation. I might go into a lengthy discussion and tell him how an airplane can keep its balance without its motor running and how it can glide to a safe landing with a dead engine, but instead I'll prove to him the possibility of his monorail being safe. He could build an auxiliary track every few miles, so if the power failed, the train's momentum would carry it to the next track. He might think this expensive but don't let him forget that emergency landing fields cost very little. He also said, "Keep your eye on the lighter than air ships." But in case of an accident, the passengers in an airship have neither wings nor rails.—L. S., Parks Airport, East St. Louis, Ill.

Every Little Worm Has a Turning All Its Own

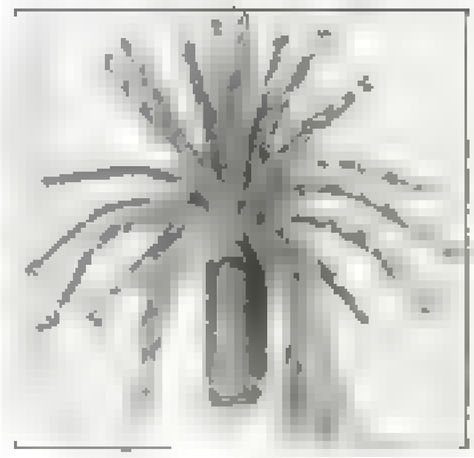
THESE PEOPLE who knock the aviation articles in POPULAR SCIENCE MONTHLY give me a stiff neck. Can't they get it into their heads that flying is here to stay? Some folks act as though it were just a temporary fad instead of a solidly built branch of industry. Oh, I know there are a lot of air minded birds who talk as though everyone who flies is a gay and daring butterfly and those who don't are just poor worms. That's all wrong, too. I fly, but I don't think that makes me giddy and superior; it's just all in a day's work. I like to read stuff on flying, but I'm willing to give the other gink a break. Let 'em have their Workshop and models and articles on this and that. I won't kick. In return I want them to keep their hands off flying, so I and my kind can have something to read. Isn't that fair? If I'm wrong, stop me.—C. A. M., Plainfield, N. J.

Why Approve Swamped Patent Office?

YOUR articles on the United States Patent Office were read with interest and O.K.d. by one who has had experience with that department. I notice that other publications are attempting to give the Patent Office a nice whitewashing. Obviously their effort along this line is dictated by interested parties. I'm glad you are independent and not easily bunked. More power to you in every way and especially in your fight for a better and swifter patent administration.—A. J., Hackensack, N. J.

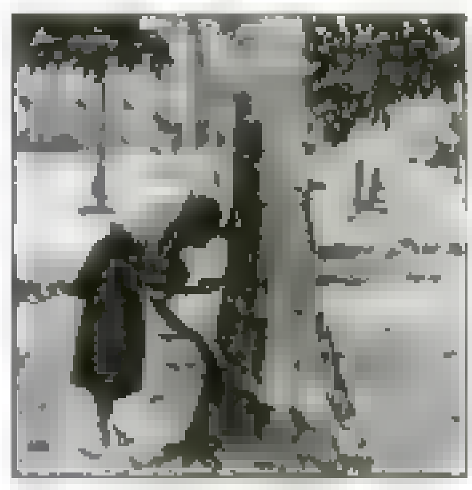
Is This Gentle Kick Well Planted?

YOU PUBLISH the latest about airplanes and autos as well as radio, television, etc., but rarely anything about trains. I have had the good luck to travel extensively, having been to the West Coast three times by train, in addition to touring a considerable part of the country. As a result I get more kick out of one train article than out of twenty about something else. I should think you could get up some very interesting articles on new coaches, the advantages and differences of the newly made Pullmans, and the technical side of our best locomotives. The tasks and responsibilities of the various employees I would also consider worthwhile.—R. A. C., Haddonfield, N. J.



1818 conversations at one time can be carried on through this new type cable. It contains 3636 insulated wires with a diameter of 2⅝ ins.

The flying telephone laboratory in which Western Electric airplane telephone equipment has been developed by the Bell Laboratories. Provision for communication between ground and plane marks a great forward step in flying.



One of the 18 materials in your telephone is rubber from the plantations of Sumatra. Western Electric goes to market in every corner of the world.

In fair weather or foul . . .

Western Electric backs up your telephone service

In foul weather, just as in fair, Western Electric backs up the Bell System with all the apparatus and supplies needed to restore, maintain or expand your telephone service.

This Company manufactures telephone equipment of every sort, with a skill acquired through 50 years' experience. At 32 warehouses it holds great reserves of telephone material available for shipment day or night. It delivers and installs the apparatus when and where needed.

The large scale manufacture of standardized equipment, too, is an economy. So is the concentrated purchasing—a responsibility that Western Electric undertakes for the telephone companies of the Bell System. All in all, here is a work of mass production, purchasing and distribution which for size and complexity has no parallel in industry.

Western Electric

THE MAKERS OF BELL TELEPHONES

... this thing called ULTRA-VIOLET

IN 1801 JOHANN WILHELM RITTER, a German physicist, made a most interesting discovery. While exploring the theories of Sir Isaac Newton and others—that light was a series of waves (similar to waves upon the water) in the ether, and that color was caused by a difference in the lengths of these waves—Ritter found waves even shorter than the visible violet. Invisible waves so short that it would take 70,000 of them to make an inch. And thus he laid the foundation for the mighty development which scientific research has since weaned from the rainbow-hued sun in the interests of better living . . . this thing called Ultra-Violet radiation.

Like visible light waves, and the infra-red and wireless waves, Ultra-Violet waves also have their function in the scheme of things. Apparently that function, in human beings, is to stir up the skin until it becomes a living laboratory, producing substances that go through the body, building up bone and flesh and keeping the system tuned-up.

Today modern science, measuring these Ultra-Violet waves with the Spectroscope, has divided them, according to length, into three classes. Near Ultra-Violet, Middle Ultra-Violet, and Far Ultra-Violet. Near Ultra-Violet rays—those waves closest to the visible—have some biological value. Far Ultra-Violet, on the contrary, is, in nature, carefully screened out by the atmosphere and never reaches us. (These powerful rays, studied by science through artificial Ultra-Violet sources, are dangerous unless prescribed by a physician and supplied under his supervision.)

According to present knowledge the Middle Ultra-Violet contributes most to better living. This is the Ultra-Violet which tans our skins—which is the dominating factor in producing Vitamin D. This "sunshine vitamin" promotes proper bone growth and blood content, resistance to disease and general well-being . . . And yet the power of ultra-violet penetration, as far as the human skin is concerned, is, at maximum, only about the thickness of this sheet of paper.

Now the scientists of General Electric Company, after years of research, have made these beneficial Middle Ultra-Violet rays available to the general public in the new G.E. Sunlight (Type S-1) Lamp. At a distance of three feet, this source, in a proper reflector, provides the same Ultra-Violet effectiveness as mid-day midsummer sunlight.

The Type S-1 Lamp is the first generator of Ultra-Violet to be offered to all, which embodies (with an adequate supply of Ultra-Violet radiation) the safety, the simplicity and the economy of the modern MAZDA lamp. Although it resembles a regular MAZDA lamp, the G. E. Sunlight (Type S-1) Lamp will not fit or operate in an ordinary lamp socket. *It must be used in a special fixture* such as the General Electric Sunlamp or the equipment made by other manufacturers.

This new G. E. Sunlight (Type S-1) Lamp is *safe*, because the bulb of special glass filters out the shorter wave lengths which are dangerous. It is *simple*, because it operates without fuss, noise or mechanism, at the touch of your fingers to the switch of the special unit. It is economical, because lamp and transformer (the transformer is part of the necessary special unit) consume only four hundred watts of electricity, and cost, on an average, only three cents per hour to operate.

In presenting, for home use, a safe, convenient way to get all the benefits of Ultra-Violet radiation found in mid-summer sunlight, the scientists of General Electric Company have not attempted to provide a cure-all or a substitute, under any circumstances whatsoever, for the services of a physician in case of illness or disease. Used in the proper unit, the General Electric Sunlight (Type S-1) Lamp is for well people—that they may remain well—and retain the vigor, vitality, mental alertness and resistance to disease which Ultra-Violet provides.

In buying a sunlamp of any kind for the dark days of winter ahead, insist that the equipment you select contains the G. E. Sunlight (Type S-1) Lamp. It is the heart of modern man-made sunshine, and is sold in accordance with the requirements of the Council of Physical Therapy of the American Medical Association.

Just as a radio tube can ONLY function properly in a set designed for its use, the G. E. Sunlight (Type S-1) Lamp MUST be used in special equipment to obtain ultra-violet radiation.

The Type S-1 Lamp consists of a "U" shaped tungsten filament (a tungsten electrode) and a pool of free mercury enclosed in a bulb of special glass.

When the current is turned on, the filament is heated immediately to incandescence.

A portion of the mercury vaporizes and an arc is formed between the electrodes. The light emitted is filtered by the special glass which transmits the most desirable ultra-violet rays to you.

The Incandescent Lamp Department
of General Electric Company
Nela Park, Cleveland, Ohio

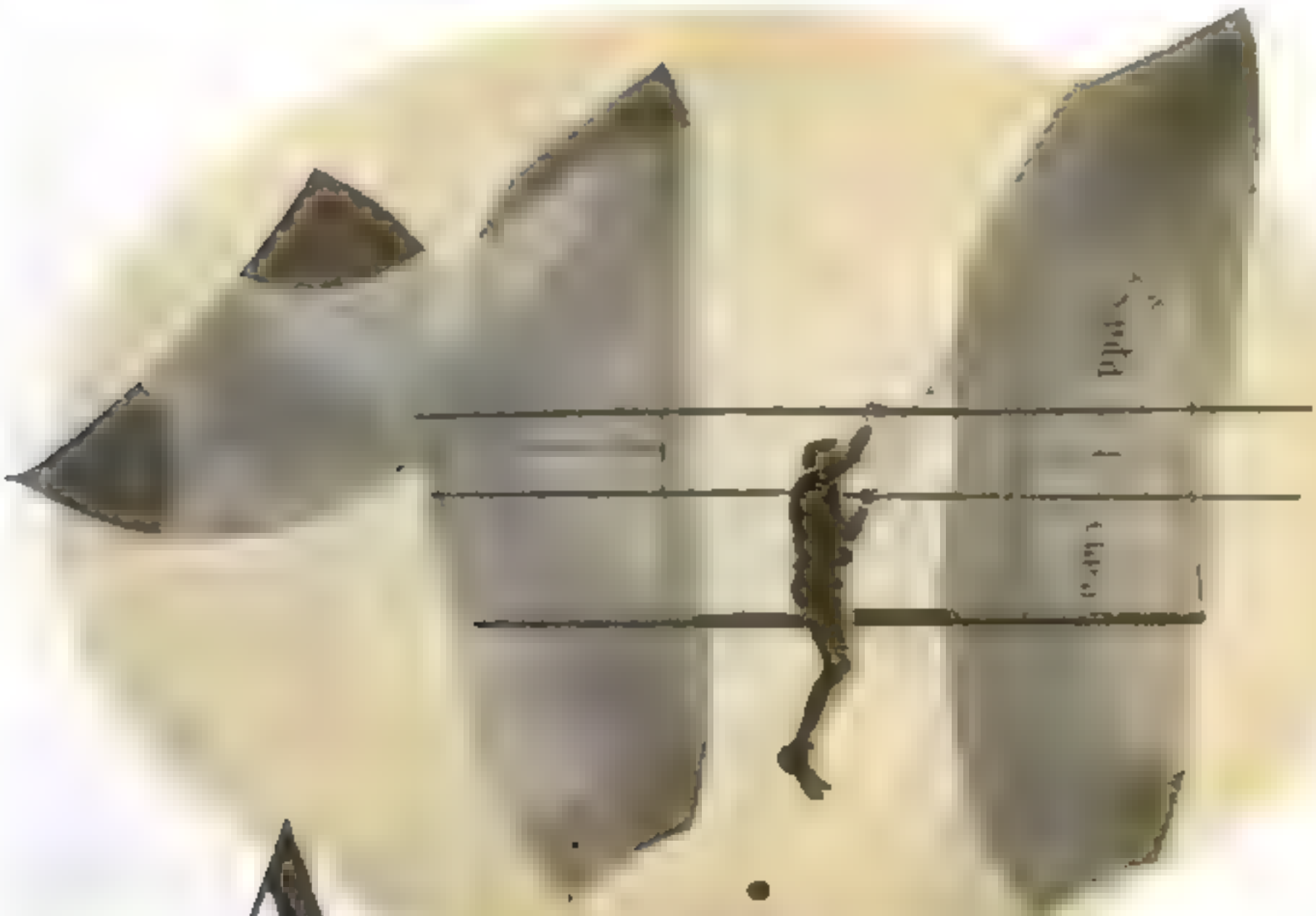
GENERAL ELECTRIC

SUNLIGHT (TYPE S-1) LAMP

Join us in the General Electric Program, broadcast every Saturday evening on a Nation-wide N. B. C. Network

Popular Science
MONTHLY

OCTOBER, 1930 RAYMOND J. BROWN *Editor* VOL. 117, NO. 4



American — *Unknown to Fame* First Man on Record *to* Leave Earth *on* Wings

BY ROBERT E. MARTIN

LESS than a dozen miles from Point Loma, California, where Jack Barstow recently soared in a sailplane for fifteen hours, lies the village of Otay. Probably not one person in a million who read of Barstow's exploit knew that just forty-six years ago Otay was the scene of the world's first glider flight.

The man usually spoken of as the trail blazer of gliding is Otto Lilienthal. Yet in 1884, a full seven years before this great German pioneer got into the air, John J. Montgomery, a lonely and misunderstood twenty-six-year-old experimenter, sailed for 600 feet down a hillside near Otay, riding a homemade monoplane patterned after a gull.

Twenty years before the Wrights, Montgomery was skirting the borders of a great invention. The story of this almost forgotten pioneer and his single-handed struggle against ridicule and poverty is one of the most fascinating in the dramatic annals of aviation. For a number of years, the writer has collected facts about this remarkable and little-known man and his history-making experiments, talking to those who knew him and corresponding with those who helped him in his tests.

Sometimes aided by frontier cowboys, always working with the crudest equipment and materials, carrying on his labors thousands of miles from the nearest experimenter in the same field, Montgomery wrestled alone with the problem that for centuries had baffled trained scientific minds. And in the end,

he built a craft that carried him into the air and flew.

Montgomery was the first man in the world to ride on wings. Yet, no monument has ever been erected to him and today, not one of the 1,621 airports in the United States is named in his honor. His years of pioneering have almost been forgotten.

John Joseph Montgomery was born February 15, 1858, at Yuba City, Calif., the first of twins. His father was Assistant U. S. Attorney General under President Cleveland. His mother had made the nine-month ox-team journey through Indian country from St. Louis to California in the gold rush of 1849.

From his earliest childhood he seems to have been interested in the air. Soon after he learned to talk, he asked his father to take him to the top of a near-by mountain, when a fleecy cloud rested on it at evening, so he could climb aboard and ride in the sky. Long before he could make his own kites, he begged his mother to make them for him.

When he was about five, the family moved to his grandmother's farm near Oakland. Here, he used to lie beside fences while his sister chased chickens over them so he could watch how they flapped their wings. A few weeks of this training had the chickens scaling the highest fences of the poultry yard. His grandmother, mystified at the way her flock was taking to the air, clipped their wings and the aeronautical experiments came to an end.

He saw his first balloon when he was eleven. Immediately kites were forgotten and he plunged into the construction of paper hot-air balloons. He made dozens of them of all sizes. The end of his balloon flying was reached when the family saw one of his hot-air bags float away with his father's best hatchet dangling below for ballast.

As a small boy, he would amuse himself for hours by throwing flat pieces of tin into the air to see which would go farthest. On one of these occasions he bent the tin into a curve and threw it. As it was nearing the ground, it struck a weed and in so doing changed its position. The result was that it paused for an instant, then ascended to a considerable height, made a complete circle and, falling with great force, stuck fast in a tree. In later years Montgomery said that this weird action of the piece of tin skimming across a barnyard led to the use of curved wings on his historic monoplane.

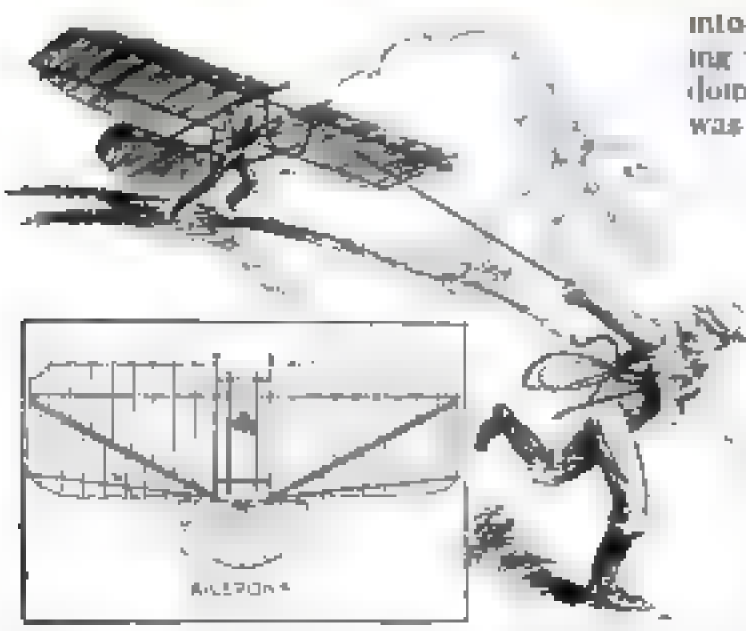
At the age of fifteen, Montgomery enrolled at Santa Clara College for one year, then completed his education in physics and mathematics at St. Ignatius College, San Francisco, where he received a Ph.D. degree. For a year after graduation, he ran a grocery store which his mother had bought. But his mind was on his flying experiments instead of upon the household staples he sold. Customers found their groceries wrapped in paper covered with mathematical calculations and mechanical drawings. In a year the store closed and the aeronautic student joined his family at "Fruitland," an eighty-acre farm near Otay, to which they had moved.

Here Montgomery set up a small laboratory and blacksmith shop in a grove of pepper trees behind the barn. When this building was washed into San Diego Bay by the bursting of the Otay Dam in 1915 it still contained the nails that he had driven into the walls thirty years before to curve the steamed ribs for his original glider.

Farming didn't attract Montgomery any more than selling groceries. He was continually stopping his hoeing or plowing to watch the gulls and pelicans that soared along the coast. One day he counted 100 pelicans in a single flock and estimated that their wings were holding aloft 1,200 pounds. He captured many hawks, buzzards, geese, sea gulls, and pelicans. He

History was made when on April 29, 1905 this glider, raised by a hot-air balloon, was launched into the air nearly a mile above the earth. It made a twenty-minute flight, landing safely

John J. Montgomery, American pioneer in flight, flew a glider [illegible] years before the great [illegible] got into the air



Drawing shows Montgomery in the first glider to leave the ground, and ailerons he used on his next plane

Just before the first launching of a glider from a balloon. At extreme right is Montgomery and seated in the cockpit [illegible] the daredevil parachute jumper, Daniel Maloney, who went aloft in the tandem glider and was [illegible] the earth.

studied their wings and compared their surface area and weight. He held up dried wings in the wind, noting their lift at different angles. He had no rules to guide him no wind tunnels or other modern equipment He was pioneering on an unblazed trail

He set up a barn door at an angle facing the wind, then released down plucked from geese to note how the tiny white feathers were carried by the air currents swirling over the flat obstruction He made a "whirly-go-round," a fence rail mounted on an upright post so it could be spun at different speeds, to test the pressure of various surfaces. All this work was done at odd moments and late at night after the hard labor of the day was over. His mother used to beg him to go to bed, fearing his health would break down. But he was sure he was nearing the secret of human flight and redoubled his efforts

In 1883 he was ready to build his first full-sized machine, a craft with flapping wings. It proved a total failure. Two other wing-flappers followed in quick succession and convinced him he was on the wrong trail.

A boy neighbor Charles Burroughs who now lives at Dulzura, Calif., after being sworn to secrecy, was allowed to help in the construction of the machines He recalls

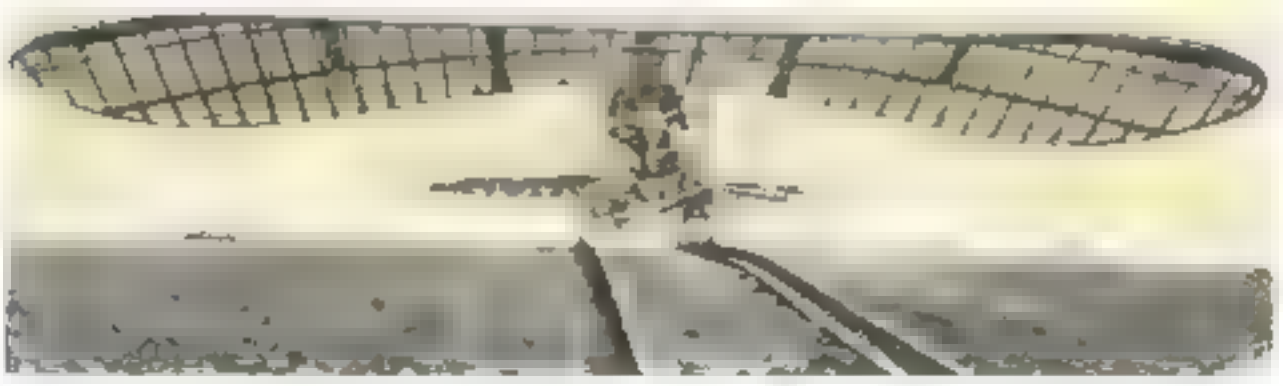
The neighbors who knew he was working on a flying machine thought he was crazy. When we went to the Otay Mountains to try out his machine he took along his rifle to give the impression he was out deer hunting. We left at nightime with the machine on a wagon and came back at night. He hunted deer on the way back On one occasion, he shot the stump of an old tree which he mistook for a deer"

The following year 1884 he constructed the historic "gull" monoplane. Its single curved wing, twenty feet long by four and one half wide, was covered with waxed silk. A movable tail guided it up and down. The operator, sitting on a little saddle below maintained sidewise balance by swinging his body toward the high wing when the machine was struck by a gust. Like the wings of a sea gull, the main supporting surface arched downward

By the middle of March the craft was ready. Early on the morning of March 17, 1884, Montgomery set out with his younger brother, James, for the history-making test. In relating what followed, James Montgomery now an attorney in Oakland, Calif., told me

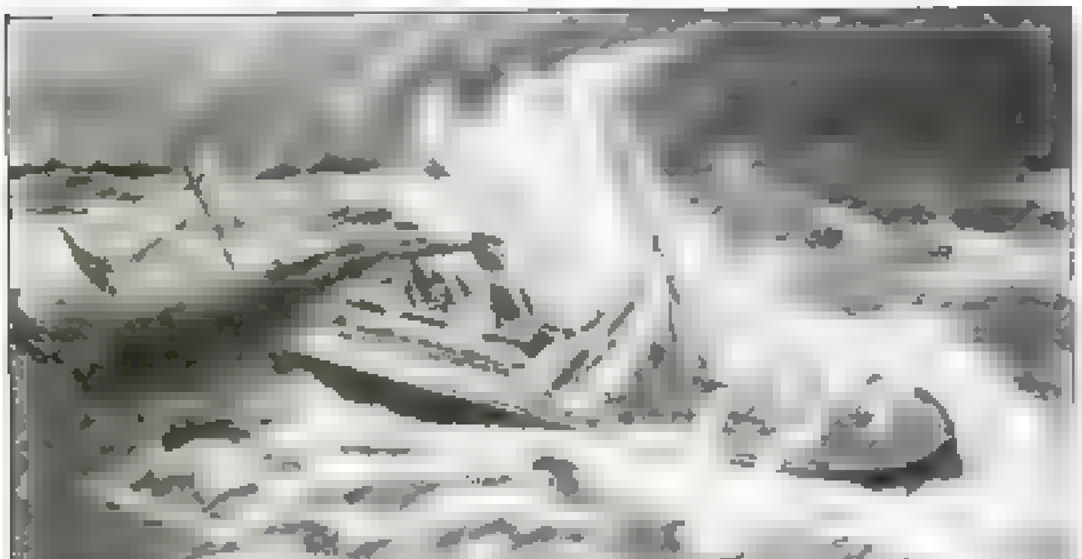
Owing to the fact that the neighbors were skeptical and inclined to ridicule, we set out early in the morning between three and four A.M. The glider was carried on a large farm wagon on top of a hay rack The selected

(Continued on page 145)



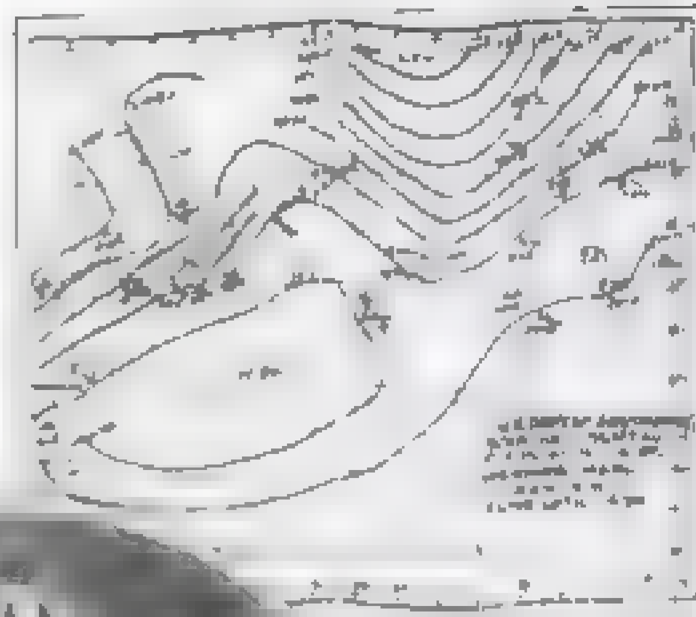
In the oval, Montgomery is seated in the last plane he built and is seen here as [illegible] flight. Below the same plane is being launched From this plane, the aviator [illegible]

Now—Radiophoto Storm Charts Sent to Ships at Sea



1 Radio operator on board ship sends out his report. From each radio-equipped vessel goes daily information of weather conditions as entered in the log. These records, all pouring into the office on shore, are sorted and sent to the Weather Bureau.

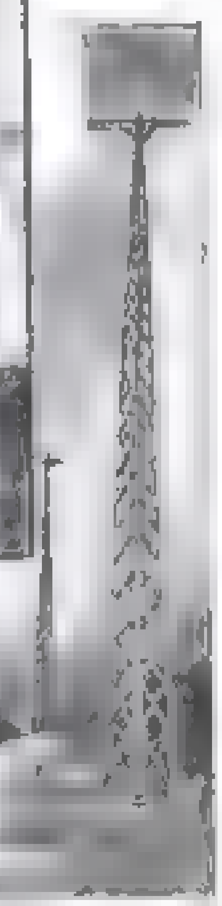
2 In the land office operators receive the weather reports. These come not only from ships but also from more than [illegible] foreign countries



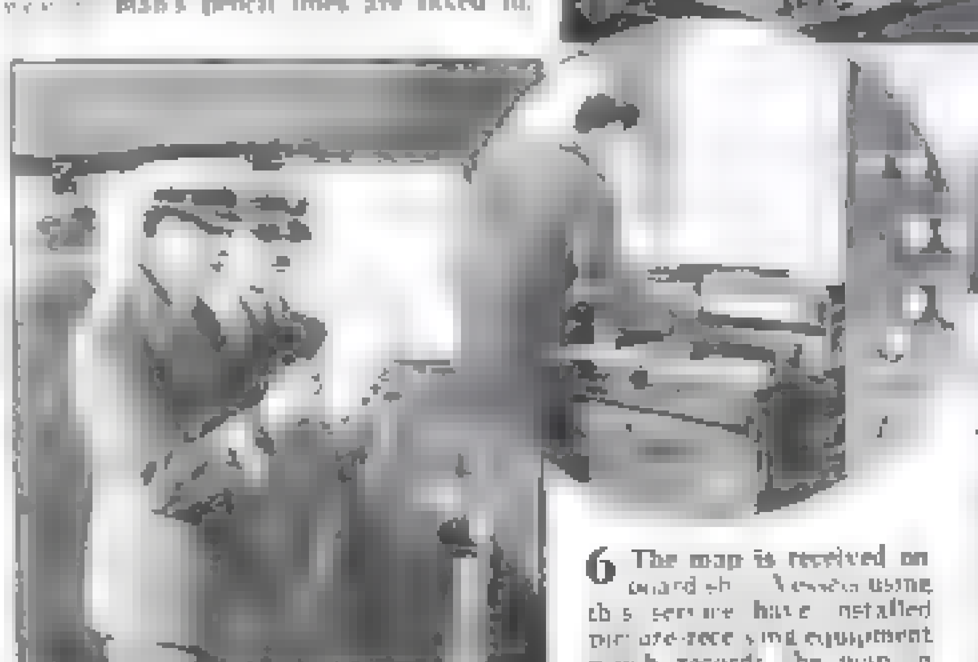
Above is a small reproduction of the first weather map transmitted by radiophoto to ships in mid-ocean.

3 At the [illegible] Weather Bureau the map is made. As fast as the messages are decoded their facts go on the map, which is then sent [illegible]

4 [illegible] the map [illegible] the radio station in New Jersey, after the [illegible] man's pencil lines are inked in.



5 The transmitting station at New Brunswick, N. J., puts the finished map on the air. Thus radiophoto enables ship captains, thousands of miles away, to see exactly what kind of weather lies before them and they can then lay a course that is free from storms.



Captain and chief officer study the map

6 The map is received on board ship. Vessels using this service have installed picture-receiving equipment which records the map in clear, accurate facsimile.

FOR the first time in history a weather map was sent by radiophoto from shore, a few weeks ago to a transatlantic steamer at sea.

Such service is now broadcast as a regular feature of the Photo Radio News which is transmitted daily to ships for experimental purposes by the Radio Corporation of America. Coöperation between this company and Dr. James H. Kimball, famous authority on ocean weather, of the New York office of the U. S. Weather Bureau, resulted in this latest step in protecting vessels at sea.

The original map is prepared by Dr. Kimball from data sent in from ships at sea and from American and European weather stations.

The codes used in transmitting weather information are so simple that just a few code words are needed to give all essential facts. For instance, "Exbrook handy, dice, signal, tense, Gemsbok" when decoded at the Weather Bureau office, means, "Steamer Exbrook, 7 P.M. July 20. Latitude twenty-six degrees twenty-four minutes north. Longitude eighty-seven degrees, six minutes west. Barometer 29.84. Temperature 84. Southeast wind eighteen miles an hour. Sky overcast."

As such reports reach Dr. Kimball's New York office the information is used to make a map of the Atlantic area. As soon as it is completed, the map is rushed to station W2XAO at New Brunswick, N. J., and then transmitted

$1,000 Cash Prizes This Month

Find the Mistakes in This New "WHAT'S WRONG" CONTEST

Good old George, who has a genius for doing the wrong thing, is to entertain and amuse you with his blunders in each of the four monthly contests of which this is the first

YOU MAY WIN ONE OR MORE OF THESE PRIZES

ONE THOUSAND dollars in cash prizes will be awarded each month for the four months beginning with this month to the winners of this remarkable picture contest. There will be a complete contest each month in which the prizes will be distributed as follows.

First Prize	$500
Second Prize	100
Third Prize	50
10 Prizes, $10 each	100
50 Prizes, $5 each	250
Total Monthly Prizes	$1,000

HERE IS YOUR chance to win a big cash prize in a brand-new kind of picture contest that is open to everybody, everywhere

Beginning with this issue, and continuing for four months, POPULAR SCIENCE MONTHLY will award 63 cash prizes a month to readers who are alert and observant These prizes range from $500 to $5. While you cannot win more than one prize a month, there is nothing to prevent your winning a prize every month, and you have four chances to win a prize of $500 and 252 chances to win a prize of $5 or more

IN THIS series of contests we introduce you to Mr George Knowitall (pronounced "Know-it-all"), whose likeness you will see at the top of this page George is full of nerve and the spirit of helpfulness, but he's a bit shy on brains and ordinary common sense

In each of the four pictures on the next two pages, Knowitall is doing a mechanical job in the wrong way In addition, each picture contains exactly four errors deliberately put there by trick photography

Your job is to figure out what Knowitall is doing wrong and to find the four errors of trick photography; then to tell us what is wrong The prizes will be awarded to those contestants who find the errors and explain them in the clearest and most skilful manner

YOU don't have to be an expert at anything to enter this contest. You don't have to be a subscriber or a regular reader of POPULAR SCIENCE MONTHLY You don't have to buy the magazine. You are permitted to get all the help you need from your family, neighbors, and friends, and you may submit as many entries as you wish.

Before starting work on the pictures, read the rules of the contest on this page They are easy to follow, but they will be rigidly enforced

George Knowitall is pretty dumb, so you should not have much trouble in discovering what he is doing wrong. As for the errors in trick photography, finding them is merely a matter of carefully examining every detail in the pictures. The contest pictures appear on the two following pages

Rules of the Contest—Read Carefully

1. Each month for four months, beginning with this month, POPULAR SCIENCE MONTHLY will print four photographs depicting the adventures of George Knowitall. In each picture, Knowitall will be doing some mechanical job in the wrong way There will be, in addition, four errors in each picture put there by trick photography You are to tell us what Knowitall is doing wrong and what the photographic errors are in each picture

2. Prizes will be awarded to those persons who point out these errors most accurately and clearly and in the most skilful manner. In case of ties, the full amount of the prize will be awarded to each tying contestant

3. Answers to each monthly contest must be mailed or delivered to the offices of POPULAR SCIENCE MONTHLY not later than the thirtieth of the month following the date of publication of the magazine in which the pictures appear. Thus, to assure consideration in this month's contest answers to the pictures in this month's issue, published September 2 must be mailed or delivered not later than October 30. No entry bearing a postmarked date later than the closing date for entry will be considered.

4. Answers may be submitted on any kind of paper, but they must be typewritten or written in ink, and on one side of the paper only. Each error must be listed separately and numbered. No changes or corrections will be allowed in any entry after submission, but any contestant may submit as many separate entries as he desires.

5. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York City Name and address of the entrant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be acknowledged and none will be returned. No letters of inquiry regarding points covered in the rules can be answered

6. There is no entry fee. You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or you can examine one at any office of POPULAR SCIENCE MONTHLY or at the public libraries free of charge. Each contest is open to everybody, except employees of POPULAR SCIENCE MONTHLY and the POPULAR SCIENCE INSTITUTE, and their families

The officials of the POPULAR SCIENCE INSTITUTE will act as judges and their decision will be final. The judges will work as expeditiously as possible in arriving at their decision and the names of the winners will be announced in an early issue of the magazine

Find the Five Mistakes in Each Photo

In each photo George is doing something wrong. Also in each photo there are four errors deliberately put there by trick photography. Find what George is doing wrong and the four errors made by our trick camera. Send us your answers and you may win one of the many cash prizes. Read the rules and list of prizes on the preceding page.

Friendly George volunteers to fix a puncture on his friend's car He takes the flat off and immediately attacks it with a tire iron while his friend bewails the lack of a spare tire Is he right or wrong

If someone asked George Knowsit to make a radio play the music faster or slower, he would make the job. So when he finds his neighbor's synchronous electric clock is several minutes slower than his watch, he offers to make it go faster He's sure the gas-glow motor is somewhere inside and that all he has to do is take the face of the clock off to get at it

Fixing a leaky garden hose just seems a trifling matter to big old George. No, the tape is at hand but that doesn't give him a moment's concern. He tackles the job by his own original methods while his hosts, who also are pretty helpless in mechanical matters, try to help him and among the three of them do they seem to be getting the job pretty well snarled up? Can you see what's wrong and give them some nice friendly advice?

Kind Brother George offers to show his beautiful cousins from the city how to plant flower seeds. He grabs a real trenching tool and quickly sets to work and here we see him depositing the seeds. The credulous ladies, who have rented the place only for the summer, expect the plants to grow and blossom in a few weeks. But as fall comes on it seems likely with George's aid that they will be waiting in vain for the appearance of their flowers.

Radio Now Walks, Rides, Flies

Announcers with Portable Equipment Work Miracles to Broadcast the News

By MICHEL MOK

A JAUNTY young man carrying a [illegible] looked like an up-ended suitcase on his back and a microphone attached to shoulder holsters in front of his chest boarded the *Thelma*, the committee motor yacht, just before the start of the latest Yale-Harvard boat races on the Thames River at New London, Conn. One of the committeemen demanded to know his business on the boat.

"I am Ted Husing, sports announcer of the Columbia Broadcasting System," the young man told him, "and I am going to broadcast this regatta."

"What with?" asked the committeeman.

Husing pointed to the suitcase on his back which was a thirty-five pound portable short wave transmitter. The other burst out laughing.

"Go on," he said. "You can't broadcast with that little thing. You need a factory for that." And he called a couple of other members to share the fun.

"All right," one of them told Husing. "We'll put you to a little test. Find out how the water is at the bridge."

But let Ted finish the story.

"The bridge, which was the finish of the race, was four miles away," he told me the other day at Columbia headquarters in New York City. "We had two short-wave receivers along the shore line, one at the start and one at the finish, and a third aboard the U.S.S. *Camden* at the New London submarine base. Herbert Glover, our director of special events, was at the bridge.

"Talking into my portable mike, I said: 'Hello there, Herbert! How's the water at the finish—rough or smooth? If it's rough, give me one semaphore signal, if smooth, two.' Glover phoned the engineer in charge of the receiver at the start that it was smooth, and a minute later our man there gave us two flag semaphores. The committee fainted."

MANY radio fans would not have shared the astonishment of these committeemen. They are acquainted with the [illegible] wonders of short-wave transmission. But it is safe to say that the average listener would have been almost equally surprised.

Remote control jobs, as all radio activities away from the studio are called, are not new. For several years prize fights, horse races, baseball and football games [illegible] in fixed localities have been reported by announcers on the [illegible] actually the [illegible] carried by telephone [illegible] and thence to the broadcasting station, where they are

The [illegible] National Open Golf Tournament at Minneapolis, Minn., as he followed the players around the course. He may have heard him report the University of Pennsylvania Relay Carnival from various parts of the track. He may have enjoyed the ex-

Center photo shows the three men who helped broadcast news of the Hunter brothers' endurance flight. Below, Lloyd C. Loose [illegible] officials carrying antenna, as Zep started its world flight.

account of the Poughkeepsie Regatta given not long ago from a moving train by Graham McNamee, crack announcer of the National Broadcasting Company.

He may have listened in amazement to Floyd Gibbons as he described, in rapid-fire fashion, the start of the *Graf Zeppelin* on her round-the-world trip in August, 1929, while walking around the Naval Air Station at Lakehurst, N. J. More recently, he may have been thrilled by Dick Powell, of the Edgewater Beach Flying Club of Chicago, who told what the Hunter brothers' endurance plane and its pilots looked like as he dropped past them in a parachute shortly before they came down at the Sky Harbor airport on July 4.

BUT he does not know how it is done. And even the radio fan with a general knowledge of the mechanics in back of those feats is unaware of the many difficulties involved in their performance and the ingenuity required of the engineers who solve the problems.

Frankly, I was one of the army of uninformed listeners. But I am no longer one of them. Officials of the National Broadcasting Company and of the Columbia Broadcasting System recently told me how these clever tricks are turned and of the thousand-and-one obstacles that must be overcome in the process.

It should be understood that there are two kinds of portable short wave transmitting equipment. [illegible] type, used in airplanes, on boats, trains, and the like, is [illegible] in four boxes, weighing a total of 300 pounds. The other is the miniature transmitter designed to be carried by a man. That used by the National Broadcasting Company weighs twenty-four pounds, looks like a portable typewriter encased in a canvas knapsack, and is strapped to the chest. Columbia uses a device weighing thirty-five pounds, which looks like a suitcase and is carried on the back.

For ordinary remote-control pick-up jobs, such as prize fights and baseball games, the broadcasting companies use a set of equipment contained in two boxes weighing seventy-five pounds each. It consists of batteries and amplifiers that amplify the microphone input to a point where it can be carried on a wire. This outfit is really a miniature studio but not a broadcasting station. It resembles the portable sound recording equipment used by the newsreel companies (P.S.M., Aug. '30, p.116), with the exception, of course, that the electrical impulses transmitting the sound are fed into wire lines instead of into machinery that records the sound on film.

Now, in broadcasting from some inaccessible spot or from a plane or a train, the same equipment plus two more boxes, also weighing seventy-five pounds each, containing short-wave transmitters and the necessary batteries, is used. In other words, what then is carried is miniature studio equipment and a miniature broadcasting station.

AGAIN, the comparison with the sound reel portable holds good, except that now the sound impulses are fed into a short wave transmitter instead of into a wire line. These transmitters range in power from seven and one half to fifty watts. An ordinary electric light bulb is rated at forty watts.

As for the knapsack and suitcase types, National Broadcasting Company's twenty-four pound unit consists of midget speech-amplifying equipment and oscillating unit. Its power is only 500 milliwatts (one half watt), one eightieth that of an electric light bulb. The canvas bag in which it is incased is padded in back and on top to prevent injury. (Continued on page 141)

On the N. B. C.'s Fifth Avenue, New York, building, where the short-wave set sent messages from roof to flying plane

T. J. Husing, seated center, is on the job giving a word picture of the Pennsylvania Relay Carnival. His short-wave report was picked up and then rebroadcast on long waves

Ted Husing wearing his portable broadcasting outfit as telling the radio fans how Bobby Jones stroked the ball at the recent Open Golf Tournament at Minneapolis. Thus equipped, Husing followed the play from the first tee to the last green

Flying with a Test Pilot

Thrilling stunts on untried wings are all part of day's work to man whose job it is to put a new plane through its paces. To give you a clear picture of this sensational branch of aviation, the author of this article rode in a machine on its first flight.

By EDWIN W. TEALE

[illegible] which he rode in a sheer 10,000-foot power dive last April [illegible] seconds.

A 600-HORSEPOWER Conqueror motor was thundering at full throttle as we walked over to the starting line at Mitchel Field, Long Island. Mechanics were warming up a new Curtiss "Falcon," with chrome yellow wings and deep-chested fuselage. William Crosswell, Curtiss test pilot, was to find out what the new ship would do and I was to go along as observer.

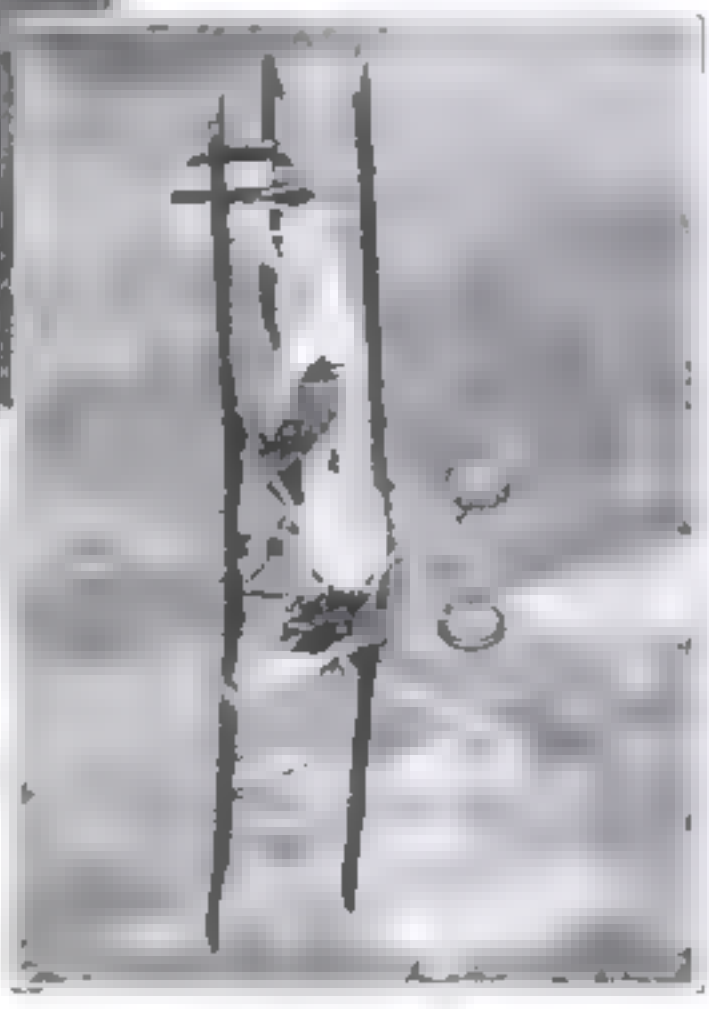
While we buckled on our parachutes, the bellow of the big engine subsided. The steel propeller idled lazily in the sunshine. The ship was warmed up, ready for the gun. Crosswell slipped a loop of green cord, holding a stop watch, over my neck. He is 25, steady-nerved, a member of the Caterpillar Club, having saved his life by a parachute leap from a disabled bomber.

Trained at the Army air school at Kelly Field, Texas, he has been test pilot and a member of the engineering staff of the Curtiss organization for the last two years. He has tested more than two dozen different types of planes, ranging from the giant 1,200-horsepower "Condor" to the "Hell Diver," a winged bullet which he rode in a sheer 10,000-foot power dive last April in demonstrating it before Navy officials at Washington, D. C.

"The first test we make," he explained, "is over the two-and-one quarter-mile speed course to get the ship's top speed. We fly low beside a straight stretch of high tension wires. Keep your eye on the leading edge of that lower wing. When the first pylon passes it, snap on the stop watch. When the last pylon flashes past the same place on the wing snap it off. Ready?"

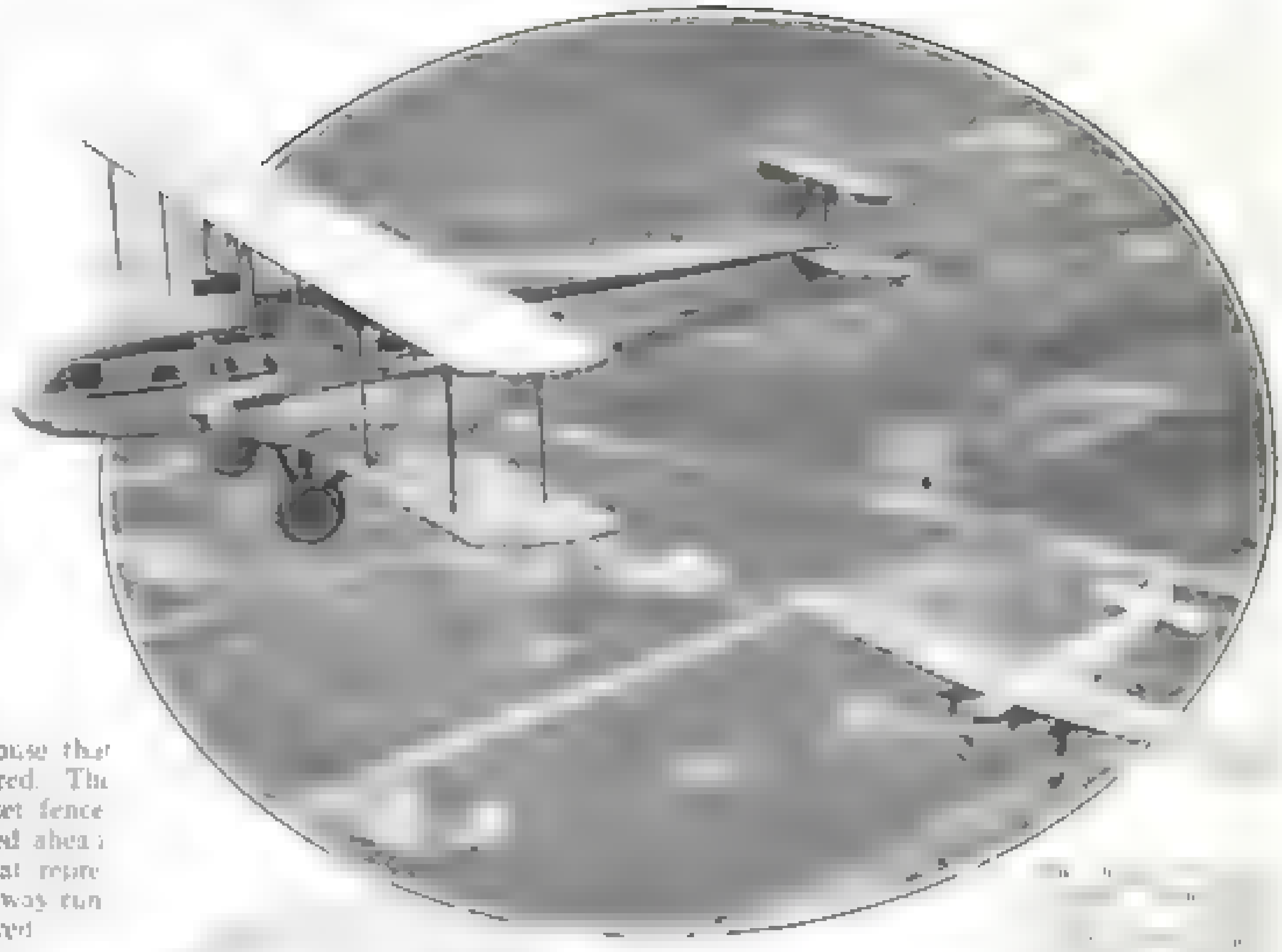
We had climbed into the machine. Crosswell settled into the forward cockpit. I buckled the safety belt to hold me in the rear compartment. Mechanics removed the chocks from in front of the wheels. Smoke shot from the exhausts as we taxied to the far end of the field, swung about and faced the wind. Crosswell ducked his head from side to side looking for other ships in the air. Then, with an earth-shaking bellow, we charged down the field with the throttle wide open. A gale tore past the cockpit. Halfway to the hangars, the wheels left the ground and we passed over the buildings 200 feet in the air.

We made a climbing turn to 1,000 feet. Then in a fast, wide circle we swung to the east. The nose dropped and the speed noticeably increased. We were approaching the high tension line. Now we were 300, now 200, now barely seventy-five feet above the ground. A golf course, with players looking up, streaked under our wings. Usually, the throttle is opened wide a full mile before the speed course is reached in order to gain max-



mum velocity for the start

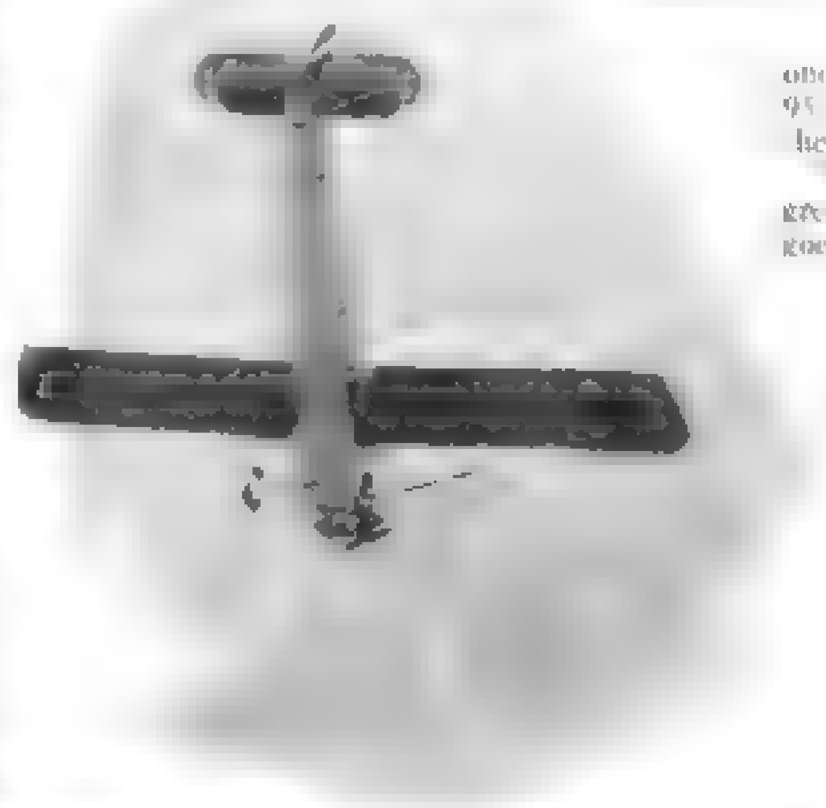
Crosswell raised his left hand from the throttle and pointed to a steel pylon, holding up high tension wires, just beyond a black crossroad ahead. It was the start of the speed course. I glued my eyes on the front edge of the lower wing. A blur of green heads. A flash of whitish-gray latticework and I snapped the stop watch. We had passed the first pylon. The race against time was on.



By focusing my gaze ahead I could see with surprising clearness, objects on the ground that swirled beneath us—a green, horse-drawn sprayer being driven between the rows of a potato patch; a gravel pit, a dumping ground where a dozen rusted auto bodies lay piled together; a greenhouse that flashed in the sun and disappeared. The pylons streamed past like a picket fence. Crosswell half turned and pointed ahead. The black ribbon of concrete that represented the Vanderbilt Auto Speedway running parallel to the pylons swerved to the left. At the point of its turn was the last pylon of the speed course. I concentrated on the wing again and snapped the watch as the steel post flashed by. As I started to look at the watch to see what time we had made, I was thrown hard against the seat. The ship had zoomed into a high climbing turn.

As we circled for the return run I looked at the watch. We had covered the two and one quarter miles in exactly 48.7 seconds. We had been hurtling through the air at the rate of 164 miles an hour and .0455 miles a second.

Speed trials are held at low altitudes in order to obtain the maximum power of the engine. The higher a plane ascends, the less power is developed by its engine because of the decreasing density of the air. Four runs, two each way are made and an average taken to determine the top speed of a new ship. When we landed, our records showed that our average speed for the four runs had been 164 miles an hour.



Rushing down in a tail spin. The Government insists planes meet this test.

Hanging by its propeller. With engine on full, the plane is pointed up by the test pilot in order to find stalling speed.

The second test was to find out the climbing ability of the plane. It started with a complicated "saw-tooth" climb. We took off and with the nose at a steep angle climbed steadily until the altimeter hand touched 1,000. The ascent had taken us 44 seconds. All the way up, the air speed had been kept at 85 miles an hour. We swooped down and started again. This time Crosswell kept the air speed at 90. Our time was 41 seconds. Then we tried it again, this time at 95 miles an hour. The air speed indicates the st[illegible]

[illegible] greater the speed, just as [illegible] goes up a slight grade at high speed wh[illegible] s down as soon as it beg[illegible] g a steep hill. In each test the engine is always kept running at full throttle. The results of the three tests showed that the best climbing angle corresponded to the air speed of 91 miles.

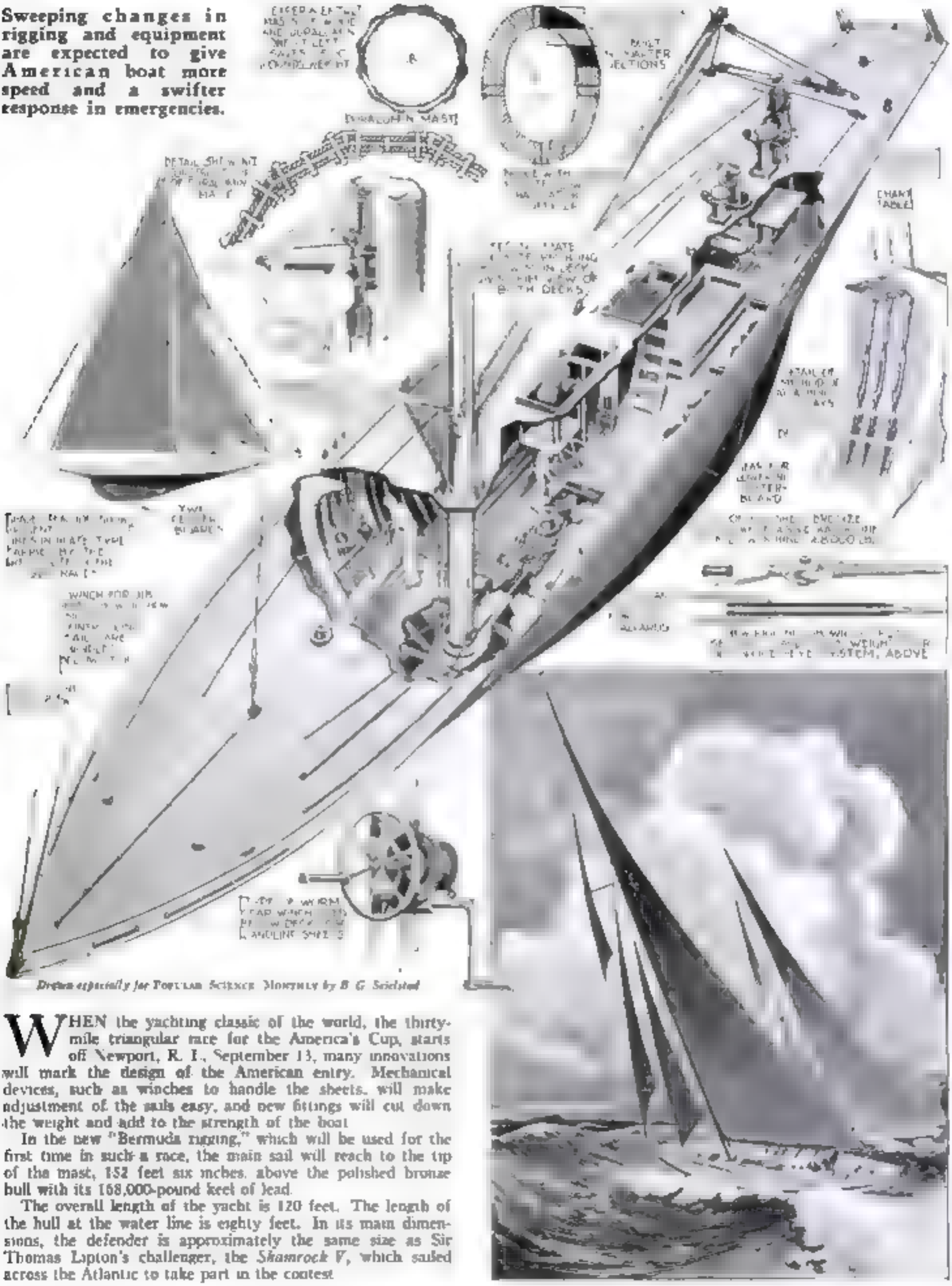
After we found the most effective angle of the climb for the first 1,000 feet, we began at 1,000 and climbed to 2,000 in the same way until we discovered the best angle as indicated by the air speed indicator for that altitude. [illegible] ing a new type of plane, the pilot continues this "saw-tooth" climb until he obtains the data that indicate the best climbing speed all the way up to the "ceiling." Then he starts at zero and climbs, using the best speeds during each step, until he gets to a height where the plane will ascend only 100 feet a minute. This is the "service ceiling" above which it does not pay a commercial operator to fly the plane. After reaching the "service ceiling," he keeps right on until the ship refuses to climb another foot. This is the craft's "absolute ceiling."

The complete test of a ship's climbing ability often consumes as much as a week. When a radically new type is tested, the work may cover three or four months. Crosswell and I rode the Falcon on only part of the tests demanded of a new design before it is put into production.

In a long steady climb, the Falcon rose to 10,000 feet. Its absolute ceiling is about 21,000. Crosswell pointed to the air speed meter. The hand had been edging slowly back, showing a smaller air speed as we rose. This (Continued on page 136)

Machines Work Cup Defender

Sweeping changes in rigging and equipment are expected to give American boat more speed and a swifter response in emergencies.



Drawn especially for POPULAR SCIENCE MONTHLY *by B. G. Seielstad*

WHEN the yachting classic of the world, the thirty-mile triangular race for the America's Cup, starts off Newport, R. I., September 13, many innovations will mark the design of the American entry. Mechanical devices, such as winches to handle the sheets, will make adjustment of the sails easy, and new fittings will cut down the weight and add to the strength of the boat.

In the new "Bermuda rigging," which will be used for the first time in such a race, the main sail will reach to the tip of the mast, 152 feet six inches, above the polished bronze hull with its 168,000-pound keel of lead.

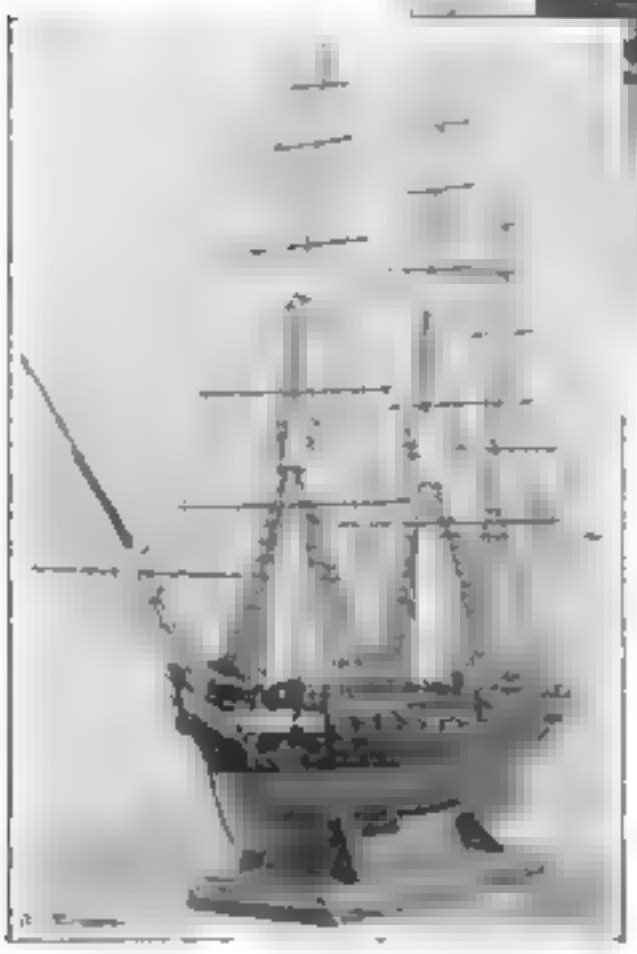
The overall length of the yacht is 120 feet. The length of the hull at the water line is eighty feet. In its main dimensions, the defender is approximately the same size as Sir Thomas Lipton's challenger, the *Shamrock V*, which sailed across the Atlantic to take part in the contest.

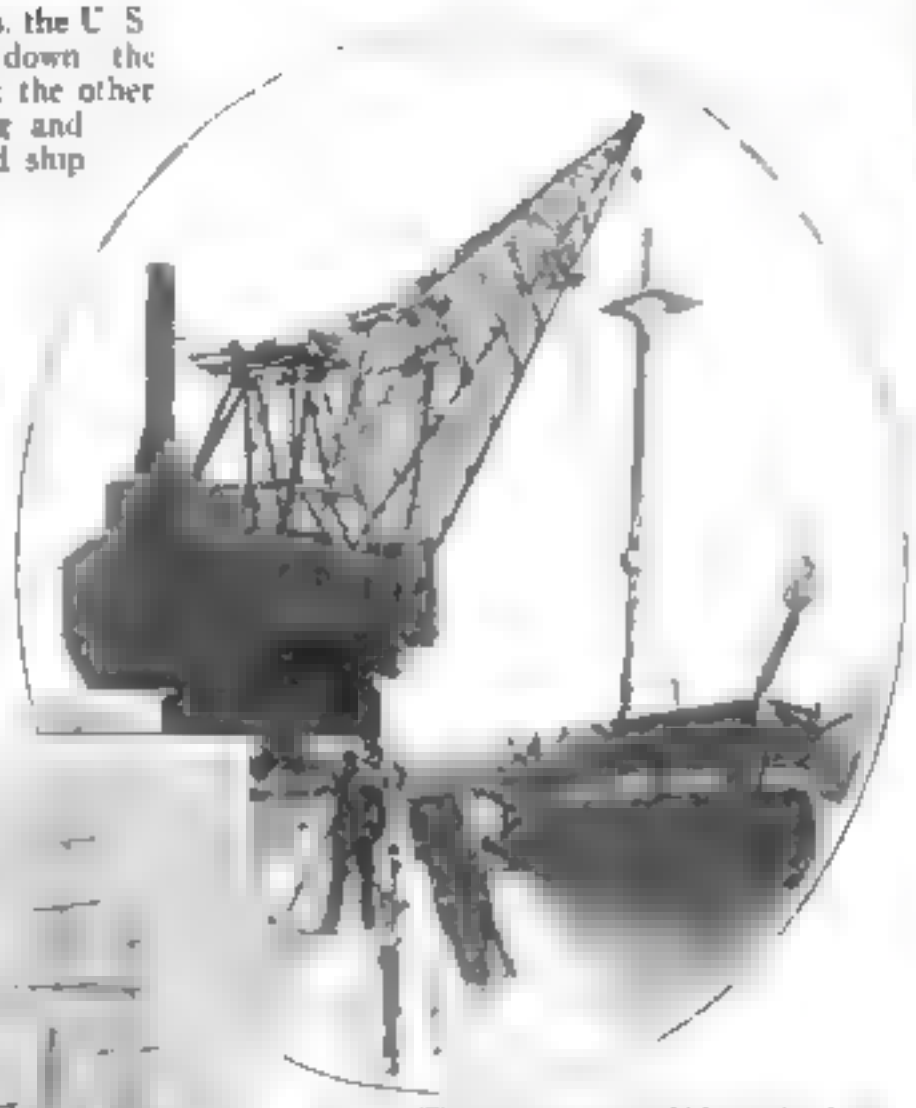
OLD IRONSIDES, REFITTED, IS GOOD AS NEW

Towed by modern tugs, the U S S *Constitution* went down the waters of Boston Harbor the other day. As soon as rigging and sails are installed the old ship will sail the seas as she did 132 years ago. The vessel, once used as a training ship, was put to bed in 1897 at the Boston Navy Yard where she lay rotting.

When news of her condition was spread Americans contributed cash to help save her. Congress appropriated $300,000 for the work. Lieut. John A. Lord, builder of such super-dreadnaughts as the *New York* and *Arizona*, was commissioned to refit the famous old fighting ship.

To insure historical accuracy, some of the lumber used was live oak brought from the Pensacola Navy Yard, where it had been submerged since 1875. Rope used on the refitted *Constitution*, of a type no longer used, had to be made specially at the Boston Navy Yard's rope works.





Above—The *Constitution*, Old Ironsides, being refitted at the Boston Navy Yard. *At left*—Model of the famous ship made from plans published by POPULAR SCIENCE MONTHLY

TRANSPARENT SLIPPER USED TO FIT SHOES

Where the shoe pinches can be pointed out instantly by shoe store clerks using a transparent slipper recently invented for fittings. This slipper is made of a synthetic transparent material.

Shoe stores that use the slipper keep a cabinet of transparent models of the standard sizes. These are tried on by the buyer until a correct size is found. Selection of shoes can then be made with assurance that the fit will be right.

Slippers made of transparent material are used by clerks to give a perfectly fitting shoe.

THIS PHONOGRAPH ALSO SHOWS PICTURES

Phonograph and projector are combined in a unique portable instrument that provides illustrated musical shows for children. While a record is playing, a strip of film automatically moves before a lens and the enlarged pictures are thrown, one at a time, at intervals of nine seconds, on a screen or wall.

Film that will not burn is used, and an electric bulb provides the light for the projector. The mechanism that feeds the film is operated by the phonograph's spring motor. The light is the only part using electric current, which is obtained from any wall socket.

Standard ten-inch records may be played by the phonograph part of the device, which is run and hand-wound in the usual way. Special phonograph records are obtainable with strips of film to illustrate them, including familiar nursery rhymes. The device may also be used as an ordinary portable phonograph, without taking advantage of the picture attachment. The instrument is housed in a case with room for ten of the special records and twenty strips of film. It weighs fifteen pounds.

All the family can enjoy this combination phonograph and still picture projector which uses film that will not burn. An electric bulb, plugged to wall socket, furnishes light.

MECHANICAL FISH CUTS MINES LOOSE

PUBLIC demonstration was recently made by the British navy of a mechanical fish for cutting loose enemy mines. This device, known as the "paravane," was one of the mystery inventions developed from [illegible] and kept secret [illegible].

The paravane at the end of a cable is dragged through a mine field, its sharp projecting "fins" cutting nets or cables to which mines are attached. The mine thus released comes to the surface where it can be destroyed by rifle fire.

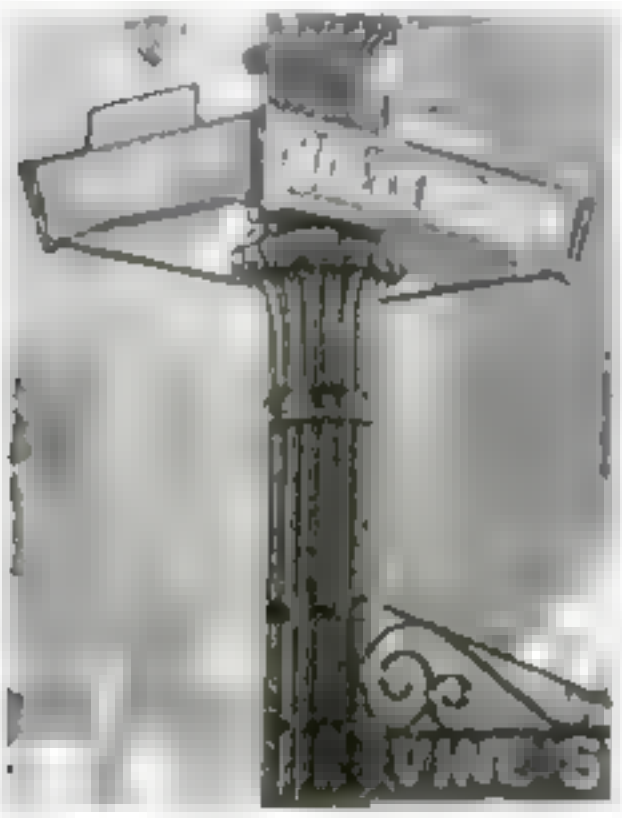
Shaped much like a torpedo, the paravane, as it slices through the water looks exactly like a big fish. Its great advantage is the swift destruction of deadly mines with minimum of danger to the destroyers.

[illegible] sun and lights already installed do the trick. Their installation has won the approval of western motorists.

STREET SIGNS LIGHTED BOTH DAY AND NIGHT

THE SUN by day and electric lights at night illuminate a new street sign recently tried out in Los Angeles, Calif. Passing motorists can easily identify a street corner at any hour without straining their eyes, as the lettering stands out brilliantly against the background.

Letters of the sign are transparent lines in a pane of black glass. Behind the glass a mirror directs daylight from the sky through the pane, and at night they do the same with light from a street lamp directly above. The sign was recently patented by H. K. Palmer, Los Angeles inventor. One of its most favorable features is the fact that it is illuminated without cost, the



BIG ROCKET MAY RISE 13 MILES

WHEN an eight-foot rocket that Prof. Herman Oberth, German experimenter has built soars aloft soon from Horst, on the Baltic seacoast, it may rise to a greater height than any projectile or vehicle ever designed by man. It will carry fuel enough for an hour's flight. Professor Oberth estimates that it will reach an altitude of 70,000 feet, about thirteen miles and may obtain valuable scientific data.

Whether it does or not should be easy to tell, for the rocket will carry a brilliant red tail light so that it can be observed during flight. As soon as it whizzes aloft from the launching platform, which is a tower resembling an oil well derrick, telescopes will be trained upon it to follow its course.

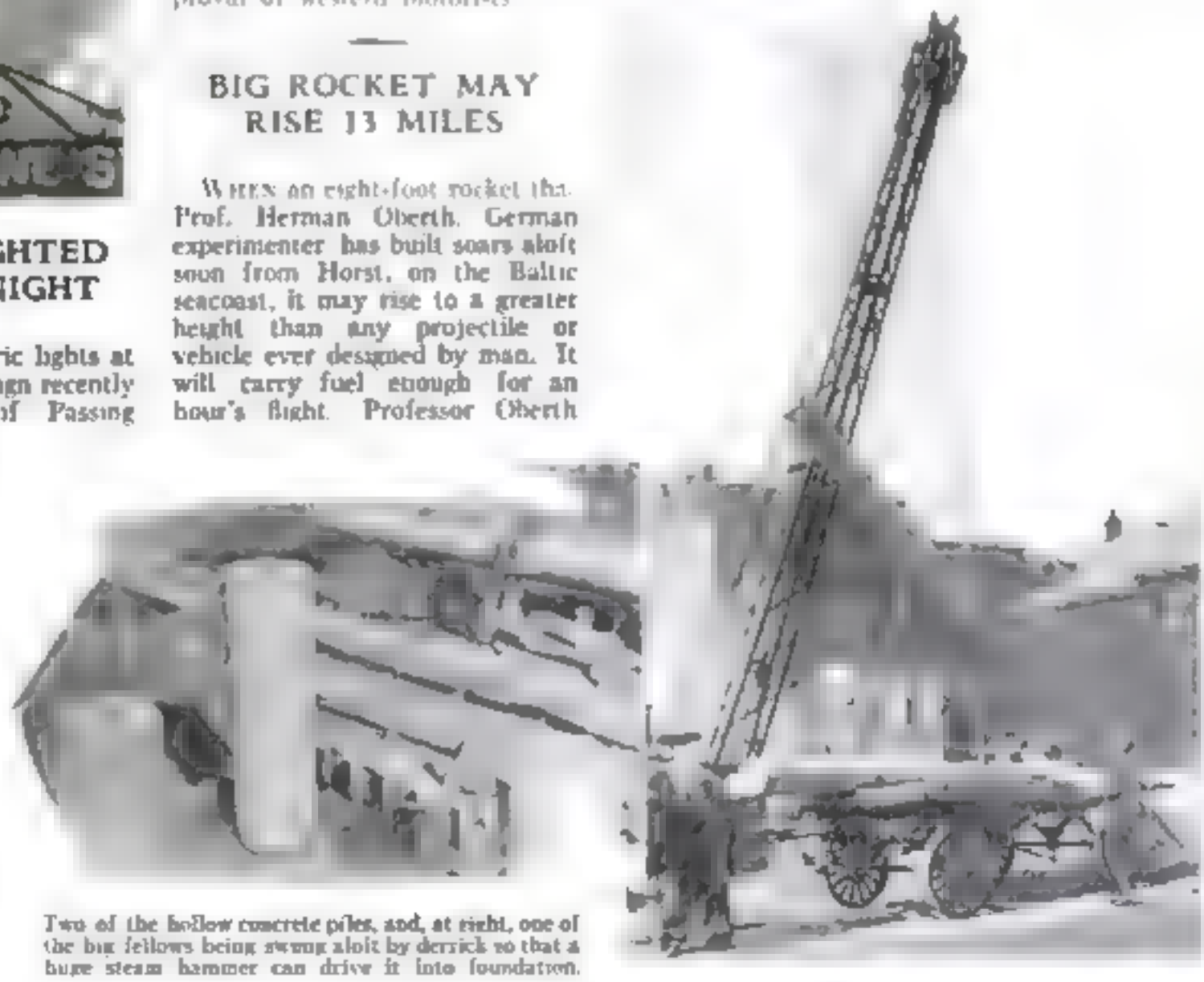
The new rocket, built of white metal, marks the resumption of Professor Oberth's attempts to build rocket vehicles that might be capable of a transatlantic flight with mail and human passengers—or even of a jaunt into outer space. It will be the first rocket, if successful, to use the powerful liquid oxygen and fuel mixture with which two Germans recently drove an automobile, a daring experiment in which one of them was killed by an explosion (P. S. M., Aug. '30, p. 25).

HOLLOW CONCRETE PILES RESIST STEAM HAMMER

HOLLOW concrete piles received one of their first try-outs recently in the construction work on a new Buffalo, N. Y. newspaper building.

These piles, called "hollow-spun," are made by a new whirling process. A metal mold, holding six half-inch steel reenforcing bars, is filled with wet cement and set spinning. The cement flies against the inner wall of the mold, leaving a hollow center.

In building the Buffalo structure the piles were driven by the usual steam pile driver into a surface of sand, hardpan, and shale. The piles were declared to be uninjured by the terrific battering they thus received.



Two of the hollow concrete piles, and, at right, one of the big fellows being swung aloft by derrick so that a huge steam hammer can drive it into foundation.

THIS POWERED CRADLE ROCKS BABY TO SLEEP

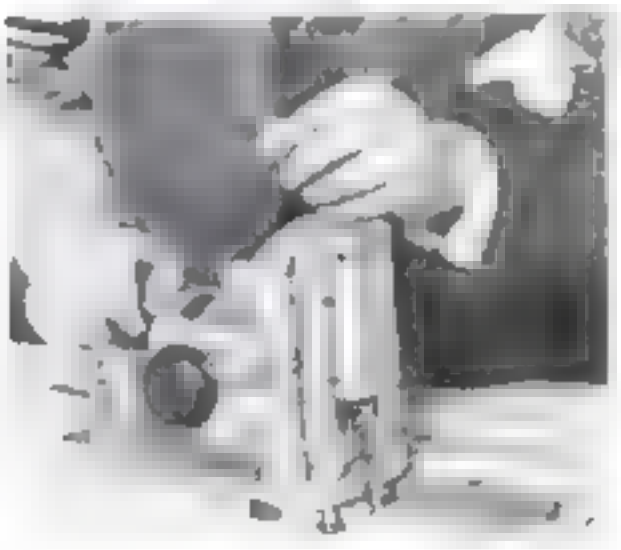
An electric cradle that swings baby from side to side has just been invented. This new method of rocking the cradle was originated by V. D. Standley, of San Diego, California.

In the new device, the customary cradle is swung from two uprights, standing on a base mounted on rollers. Turning a switch starts the cradle rocking by means of a lever which pulls downward alternately at either side. Drawers in the base afford plenty of room for storing toys and other playthings.

ELECTRIC CUTTING TOOL IS PORTABLE

For cutting wallboard and wood of less than an inch thickness, a new portable electric cutting tool has been invented. Bevel or slant edges may be cut with a special attachment for the machine.

An aluminum body makes the tool light and easy to handle. Hand plungers determine the depth of the cut and move the machine along the desired design. A number of special tools to be used for cutting a wide variety of materials are available. The cutters are driven by gears.



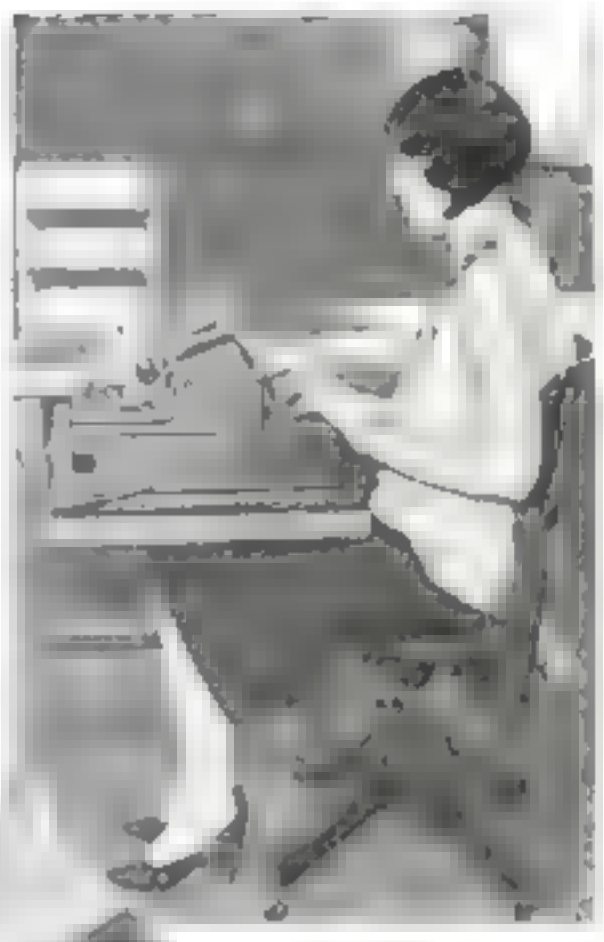
This portable tool is electrically powered. Aluminum body makes it easy to handle.

ALL-ELECTRIC TYPEWRITER NOW HERE

On a new all-electric typewriter every operation is carried out directly from the keyboard. On the new machine, carriage return, shifting for capital letter, back spacing, and indentation are carried out by power from the keyboard itself.

An automatic form letter writer can be incorporated with the typewriter. By means of a perforated paper roll, an unlimited number of duplicates of a message may be typed. One operator can keep four or five machines going, merely typing the salutation.

Estimating a normal day's work at 75,000 impressions, the typist moves in a day 20,000 pounds to a height of one foot. In the new automatic machine electricity takes care of more than ninety-nine percent of the actual mechanical work.



A new all-electric typewriter does 99 percent of the work. Various forms can be typed at the key board.

NEW PIANO PLAYER CAN BE CARRIED IN CASE

Operated by hand power, a portable piano player has been perfected by W. R. Wearham, an English inventor. It folds for carrying, and is said to weigh less than many portable radio sets.

The player, which can be used on any ordinary piano, is worked by the handles which pull two levers up and down. Pneumatic action created by this pumping operates directly on the keyboard. Piano rolls of the usual size can be used with the instrument, which has an eighty-five-note range and can be played by anyone.

CHINESE RIVER MOVES ITS BED NINETY MILES

Twenty-five years ago Sven Hedin, famous Swedish explorer, predicted that the lonely Tarim River, in the interior of China, would leave its bed in the sands of Karakoschun and move ninety miles away to Kuruk-daria. His daring prophecy has come true, for the river choked with sand and earth, has made the journey.

RAIN CLOSES THIS WINDOW

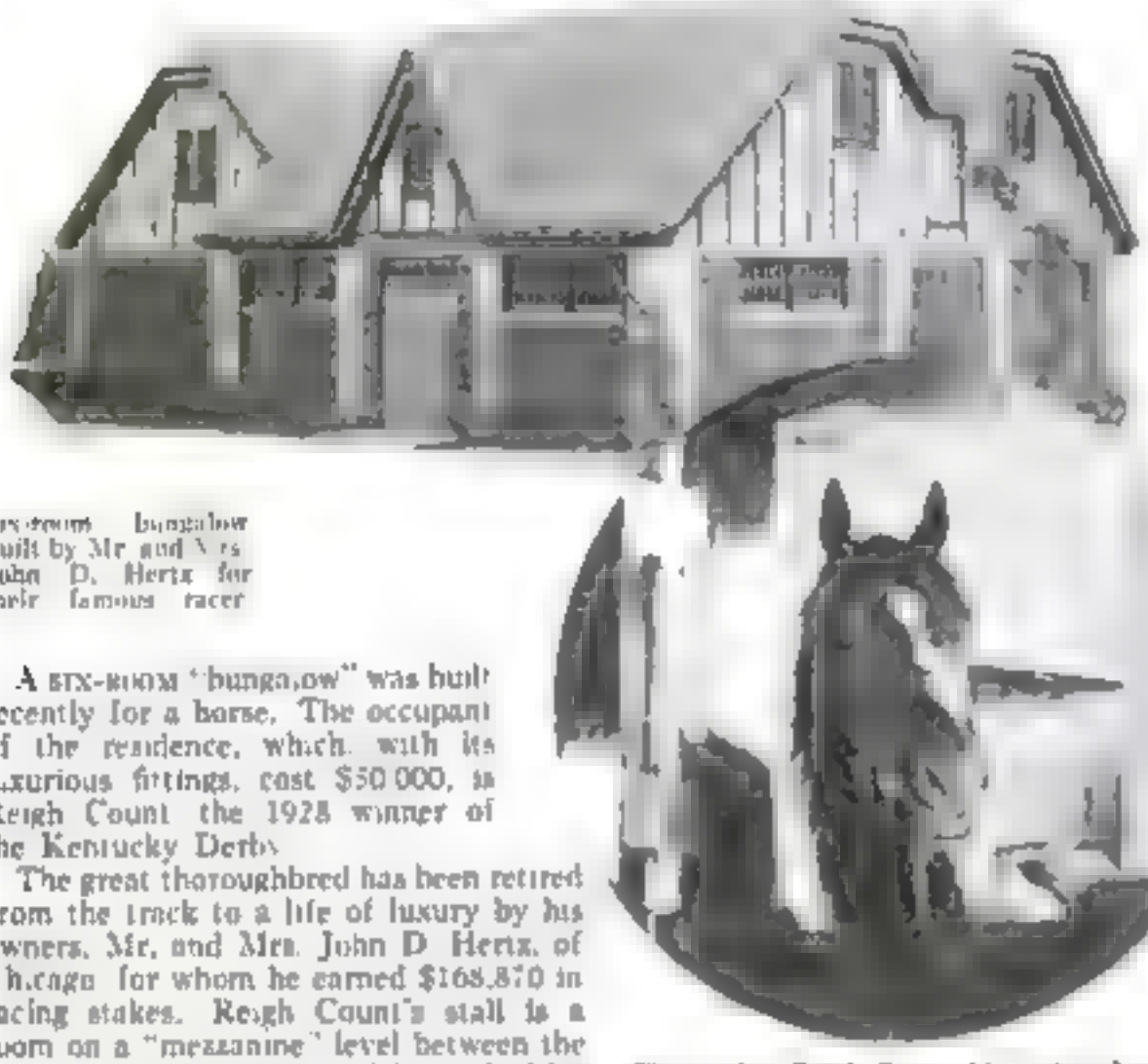
When the first patter of rain descends, windows are slid automatically shut by a new electric device. The moisture of the rain closes an electric contact to close that starts the motor. Thus it serves as a watchdog over an open window, saving upholstery and furniture from possible ruin. The device, containing a motor run from the light socket, is easily attached to any window sill.

RADIUM IN LAKES MAKES ONTARIO'S FISH BIG

Water charged with radium may account for the big fish of the lake country near Paudash, in the Canadian province of Ontario. So investigators have concluded, after visiting fishermen reported extraordinary numbers of five-pound and larger bass. While the fishermen were delighted, they were puzzled by the size of the abnormally developed fish.

Tests of the lake waters of the vicinity, made at McGill University in Montreal, show the water as strongly charged with radioactive material as are many of the famous spas of Europe. Radium, like X-rays, has been shown in laboratory tests to produce freak individuals in breeding animals and plants, and it therefore may be the cause of the remarkable run of large fish.

GREAT RACE HORSE GETS $50,000 HOME



Six-room bungalow built by Mr. and Mrs. John D. Hertz for their famous racer

The mighty Reigh Count, his racing days over looks out from the stall in his luxurious home

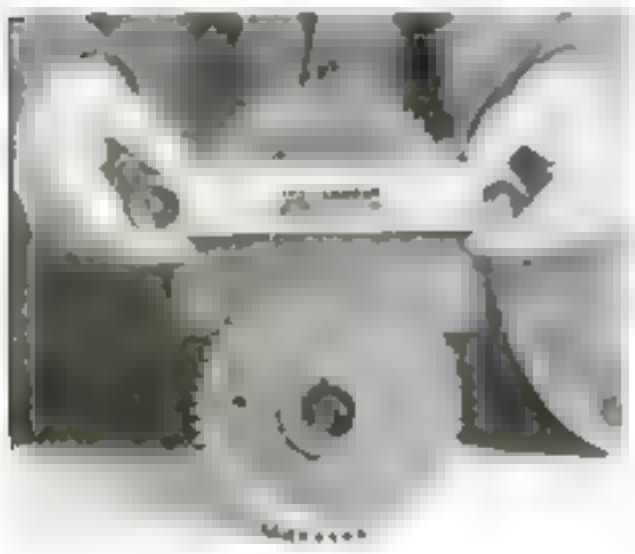
A SIX-ROOM "bungalow" was built recently for a horse. The occupant of the residence, which, with its luxurious fittings, cost $50,000, is Reigh Count the 1928 winner of the Kentucky Derby.

The great thoroughbred has been retired from the track to a life of luxury by his owners, Mr. and Mrs. John D. Hertz, of Chicago, for whom he earned $168,870 in racing stakes. Reigh Count's stall is a room on a "mezzanine" level between the first and second stories and is reached by an inclined walk. It is lighted with special window-glass, which permits the healthful ultra-violet rays in the sunlight to enter. Brass trimmings are used throughout the building, while Reigh Count's stall is finished tastefully with oak wood and tile.

ELECTRIC EYE OPENS AUTOMATIC DOOR

HOTEL WAITERS and waitresses, balancing trays of dishes, need not pause to open a new type of door, developed recently by the General Electric Company, Schenectady, N. Y. As if by magic, it opens of its own accord, stays open long enough to permit them to pass through, and then silently closes again.

The [illegible] remarkable [illegible]



MACHINE PARTS' SIZE RECORDED INSTANTLY

WHEN the thumb clamps of a new "adjustable template" are loosened and it is pressed against a gear wheel or other odd-shaped piece of machinery, hundreds of thin brass leaves move to take the piece's outline. Thus an instant record may be made of the dimensions of a shop part. Turning the thumbscrews back again locks the leaves, and the template is then carried to drafting or file room. There a permanent record is made. The device also checks machine parts for wear and shows whether it has reached a dangerous limit.

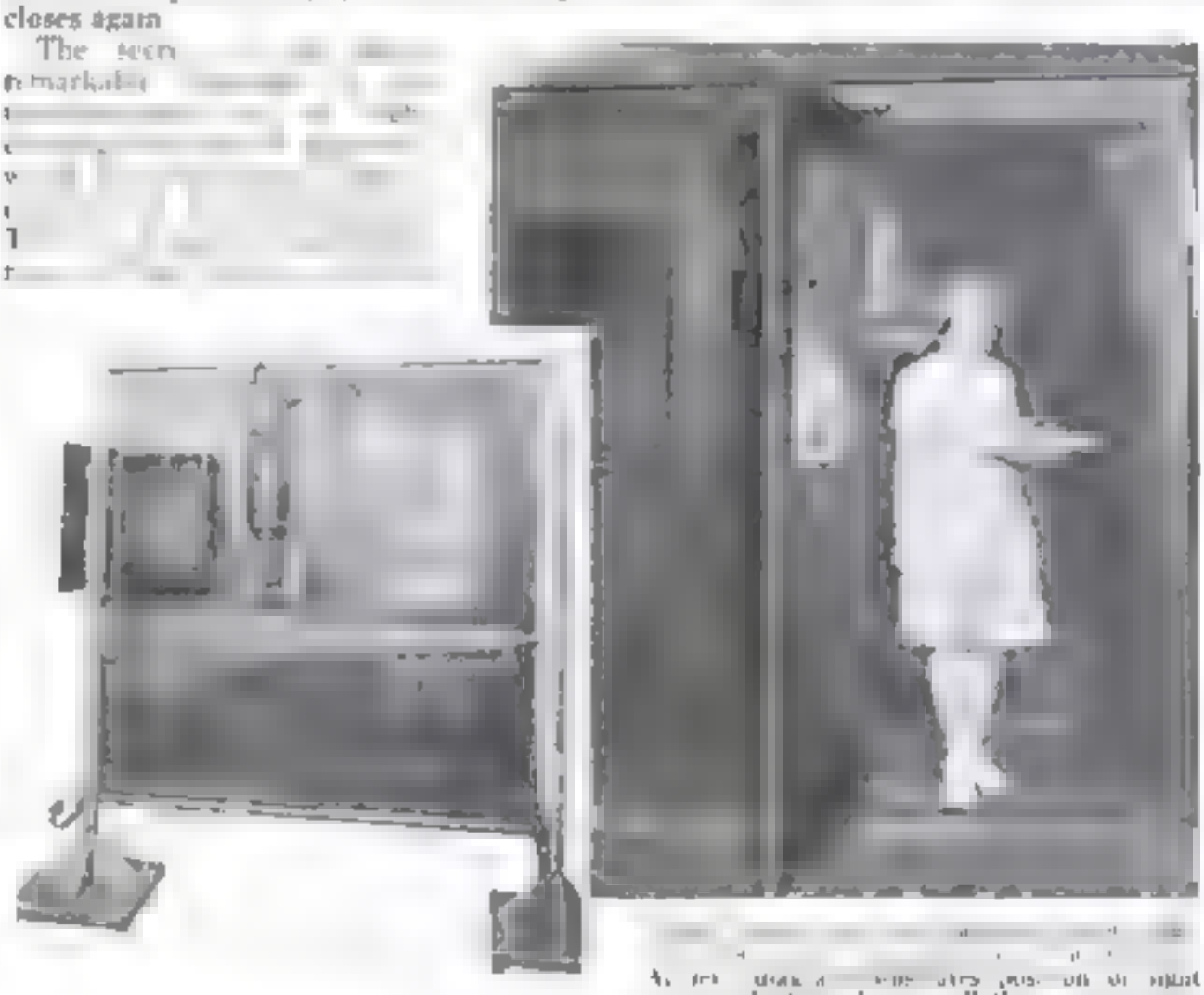
current. When the light ray is interrupted as by a passing person, the current fluctuates. Amplified by three large vacuum tubes, it sets in motion a small motor which operates a hydraulic door-opener. After the person has passed through and a pre-determined time has elapsed, the door closes again of its own accord.

TALKIES TO REVIEW 61 CENTURIES OF FIGURING

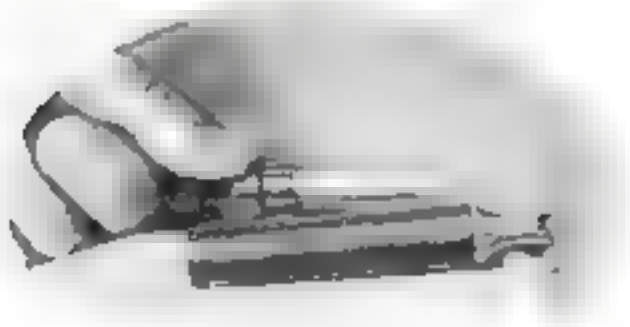
TALKING movies at the Chicago World's Fair in 1933 will exhibit both new and old wrinkles in mathematics such as Einstein's theory of relativity, differential and integral calculus, the ever-elusive problem of "squaring the circle," and the hypothetical "fourth dimension." They are the latest aid in reviewing what people have learned about figuring during the sixty-one centuries or so that they have been at it.

Only recently have mathematicians realized what ancient Egyptians and Babylonians knew about numbers. The Greeks, from 600 B. C. on, are generally considered the first mathematicians. But the earliest dated event in history, the establishment in 4,241 B. C. of the twelve-month, thirty-day Egyptian calendar with its five additional feast days, implied some use of mathematics, according to Prof. R. C. Archibald, Brown University expert in this field. As early as 3,500 B. C., the Egyptians wrote numbers in units, tens, hundreds and so on as we do, although pictures of objects were used for numerals. The number 1,234, for example, would be written in pictures as a god, followed by two tadpoles, three heel-bones and four lotus flowers.

One practical application of the Egyptians' skill at figuring was the building of the Great Pyramid, with its precisely-measured base and almost perfect square set north and south with remarkable accuracy. A less familiar but even more extraordinary surveying feat of engineers of the same period was marking the "nilometers" along 700 miles of the crooked river Nile.



[illegible] beam and photo-electric cell that [illegible] motor



RAZOR HANDLE HOLDS PENCIL TO CURE CUTS

Shot in the user of this new razor cut himself while shaving, a remedy is near at hand The hollow handle contains a styptic pencil, which is withdrawn at once and applied to the cut. It sterilizes the wound and stops the flow of blood. The pencil is replaceable with a new one when it is nearly used up.

ALUMINUM GAS PIPE WILL BEND TO AVOID ANGLES

Flexible gas pipe, made of aluminum is now on the market for connecting gas stoves and heaters to the main pipe line. Used for permanent installations, it eliminates the need for the angle fittings necessarily employed when rigid pipe is installed. The new thin-walled tubing may be bent to any desired shape and is capable of withstanding high pressures This flexibility, it is claimed, gives it ease of installation and repair

NEW LIFEBOAT IS DRIVEN BY LEVERS

Wearing life preservers, his lifeboat crew mans a craft that has no oars, but is driven with levers that work a propeller Thus there is room for more passengers in the boat.

More space for passengers in a lifeboat was the need that inspired the invention of a novel craft propelled by levers instead of oars. When the crew pulls on the swinging levers, its muscular effort drives a propeller at the stern of the boat Because the wide sweep of oars is eliminated, passengers can face each other on double seats. The new lifeboat was demonstrated recently in England

The work of operating the lever is said to be less exhausting than swinging an oar and the speed at which the new type of craft is driven is practically the same as that of the oared boat in spite of the greater load which it will carry

CAN WATCH WATER TURN TO HOT ICE

Hydraulic pressure forces the piston into the chamber and the observer at eyepiece sees water change to hot ice.

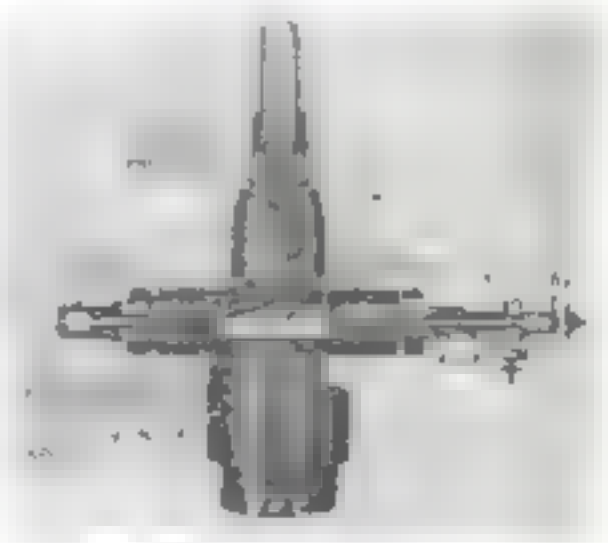
Through a round glass window smaller than a man's thumbnail, Prof. Thomas C Poulter, head of the physics department of Iowa Wesleyan University peers at things that no man before him has seen. He watches a piston squeeze a confined sample of water, oil or radium with the almost inconceivable pressure of 450,000 pounds to the square inch.

This is close to the record pressure, 600,000 pounds per square inch, with which Prof. Percy W Bridgman of Harvard University, turned water into ice hot enough to boil an egg. It surpasses the capacity of the machine with which Jean Basset French engineer, turned "incompressible" liquid petroleum into paste Neither of these experimenters, however could watch what was happening inside his machine

A desire to *see* these marvels with his own eyes led Prof Poulter to build his windowed apparatus. This device is a hollow block of tough steel. Two tiny windows of glass, seven sixteenths of an inch in diameter and five sixteenths of an inch thick, wall off material under test from an observation tube. Resting loosely on oil smeared steel rims, they withstand fifteen tons force when a hydraulic press drives in a rubber-tipped piston. Should one break, a "safety window" stops flying splinters. A telescope or other instrument safeguards the observer

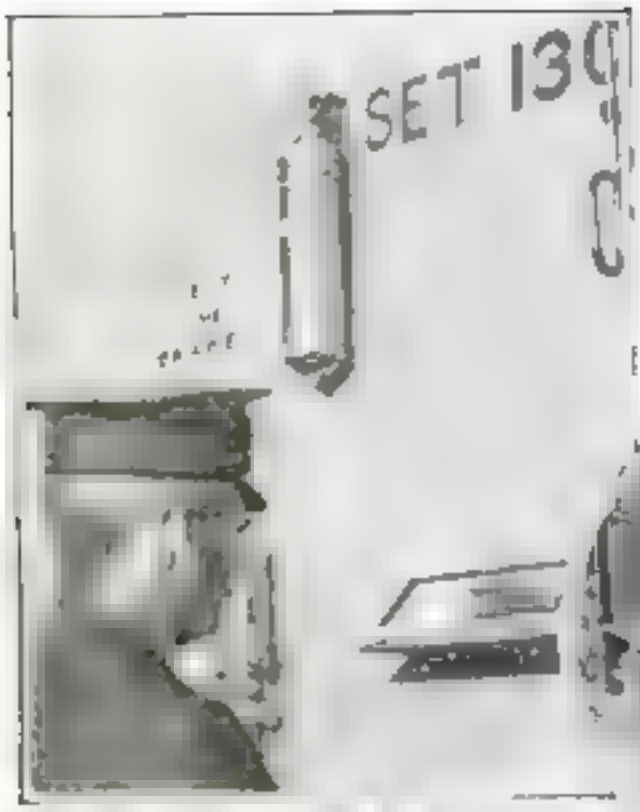
"While at present we feel that we have a relatively safe arrangement," Prof Poulter told Popular Science Monthly "we have had some rather exciting moments." Once a pressure cylinder under 200,000 pounds to the square inch exploded. A loud report, and two pieces whizzed across the laboratory, barely missing Prof. Poulter and his assistan. Another time, oil shot from a leak with sufficient force to inflict upon him a painful bruise

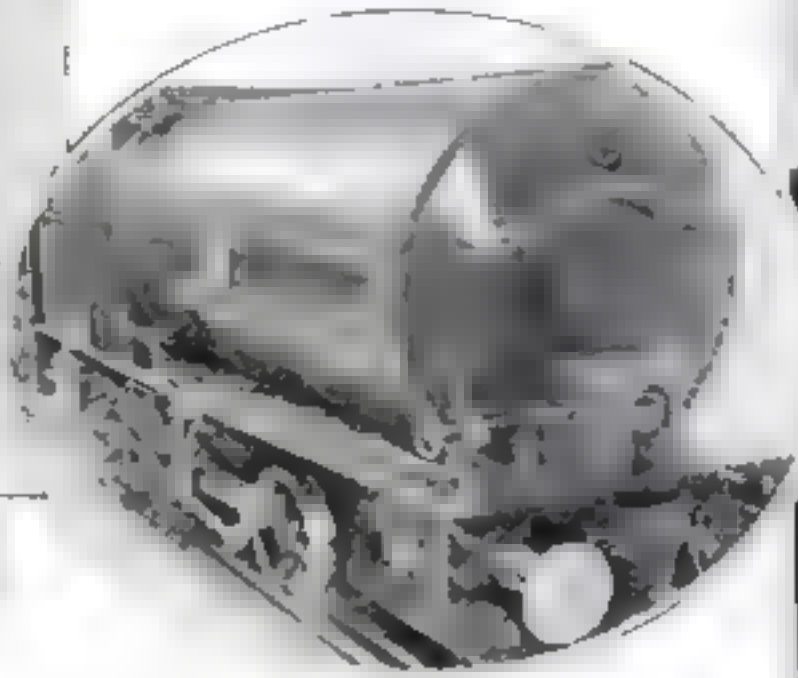
With his new machine Prof. Poulter discovered that "Ice VI," a rare "hot" form of ice which exists only at extraordinary pressures, will twist a polarized or flattened, beam of light much as rock crystal does. This and other optical experiments made possible by the windows are revealing new secrets of the structure of matter. In another test, Prof Poulter found that the most terrific pressures did not slow or speed the natural breaking up of radium

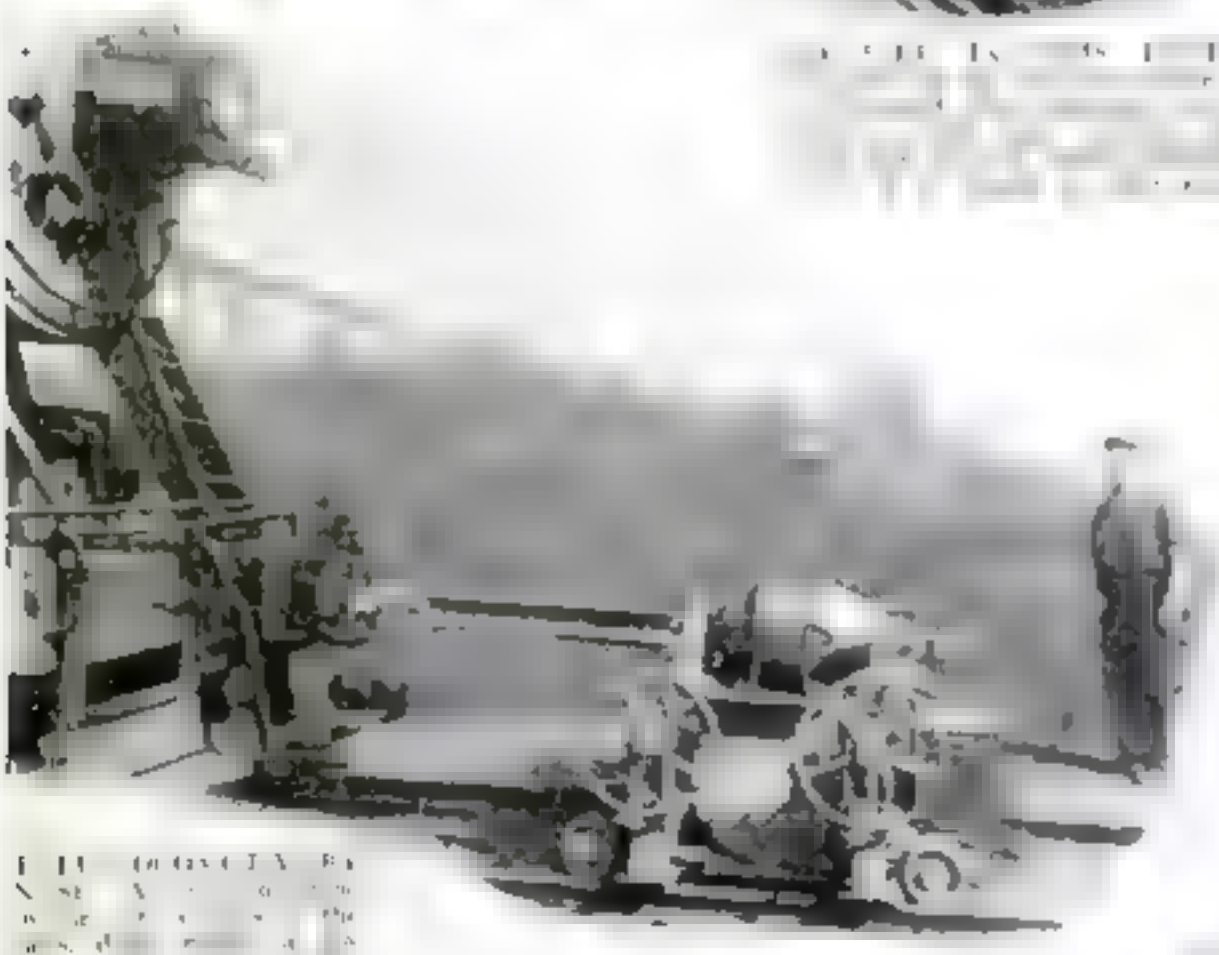


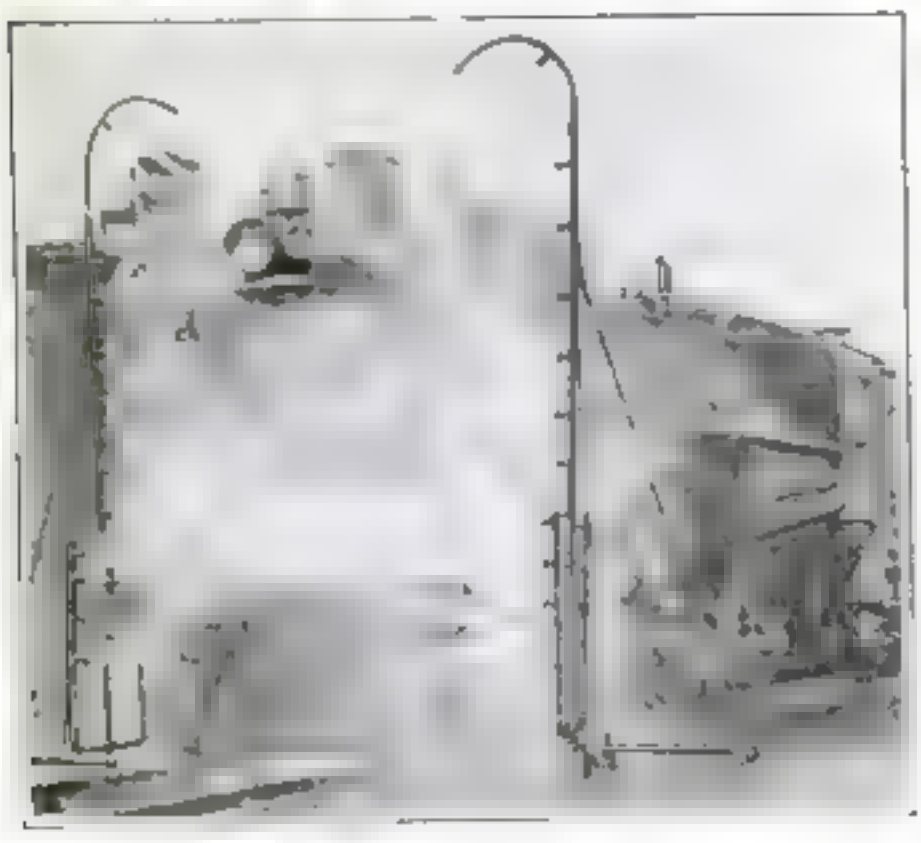
This simplified drawing shows piston that applies pressure and the safety window

Latest Improvements Designed for Use by Railroads





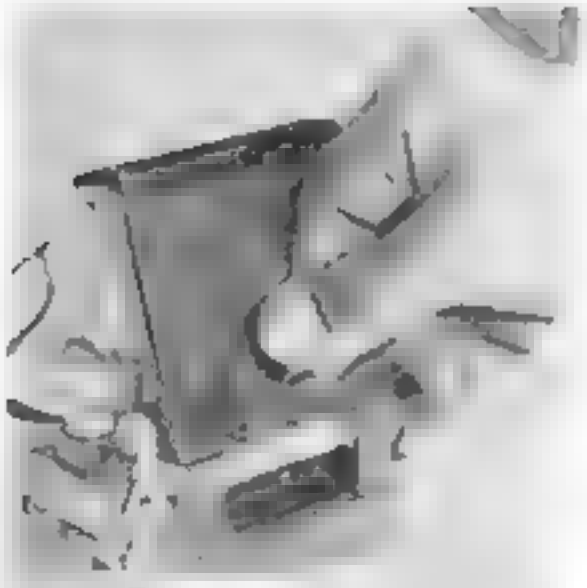




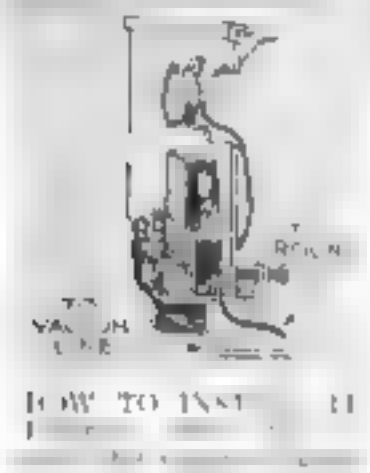
MONARCHS OF THE RAIL GET A BATH When an engine runs upon a certain section of the track it automatically operates this washing machine, which cleans the engine with hot water and steam. When done it shuts itself off.

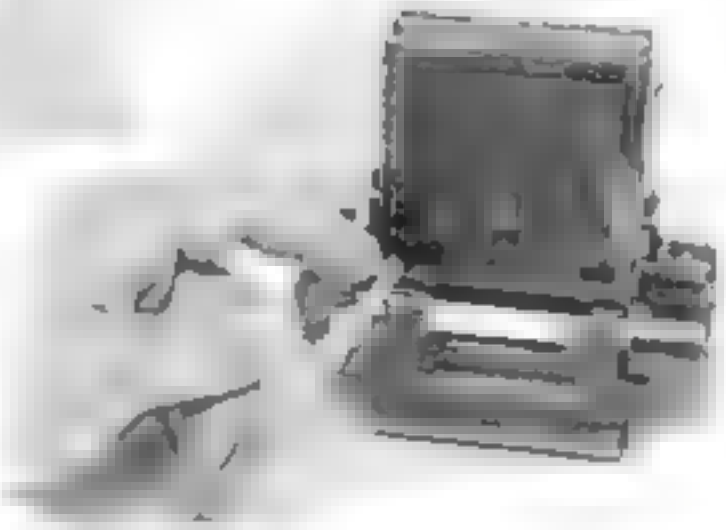
at any given point. The device is considered economical no brakeman is needed on the cars.

Six New Ideas Developed for Your Auto

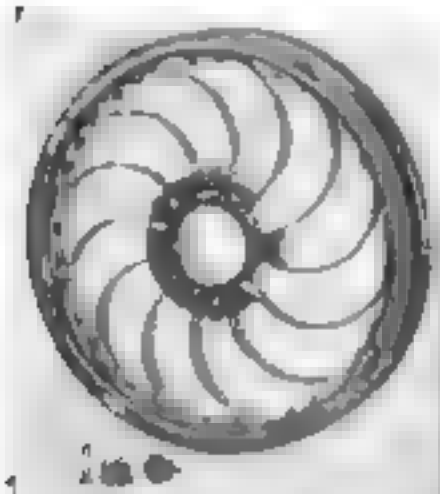


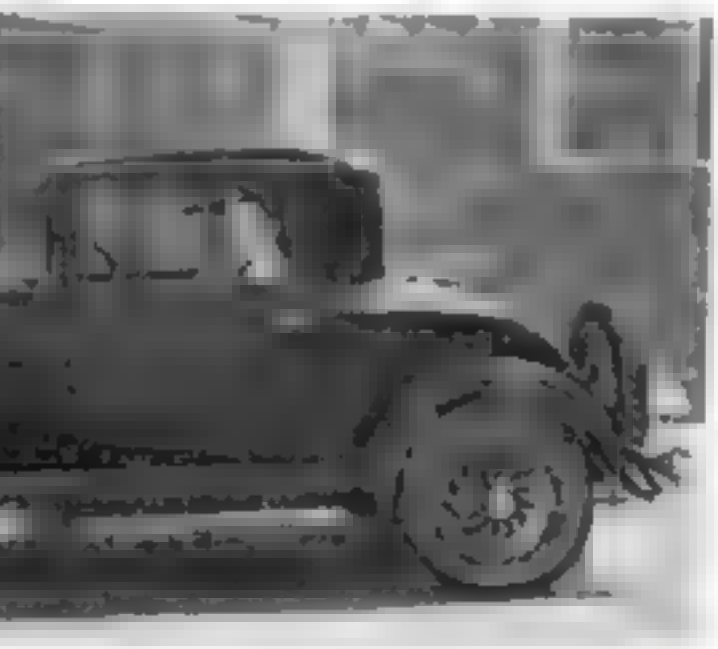
GAS AND BRAKE COMBINED. With this pedal installed in your car, a twist of the foot to the right turns on the gas and speeds up the engine. Moving the foot to the left shuts off the fuel and if the pedal is depressed at the same time the brake is applied as in the usual way.



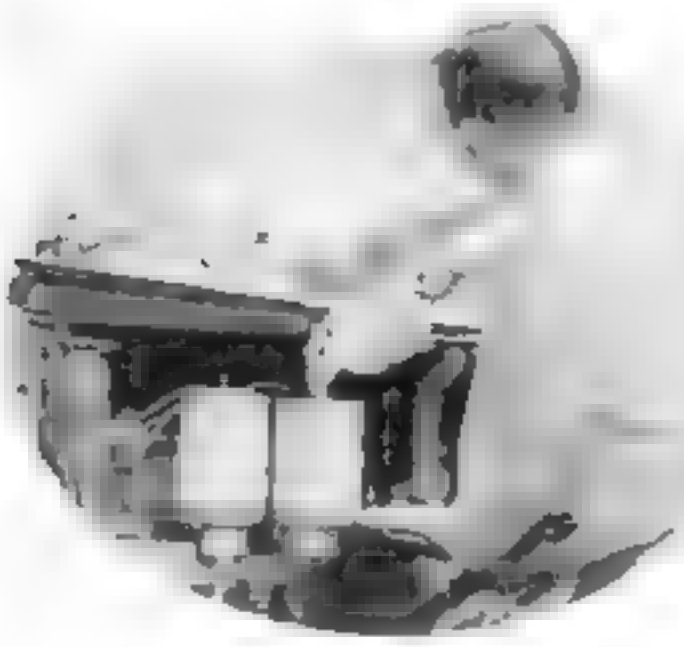


CHARGES BATTERY WHILE YOU SLEEP. When the car is put in the garage for the night a plug is shipped into the socket on the instrument board and the work of charging the battery begins. The battery charger is attached to the wall connected with electric light wire and the driver can start it without soiling his hands.

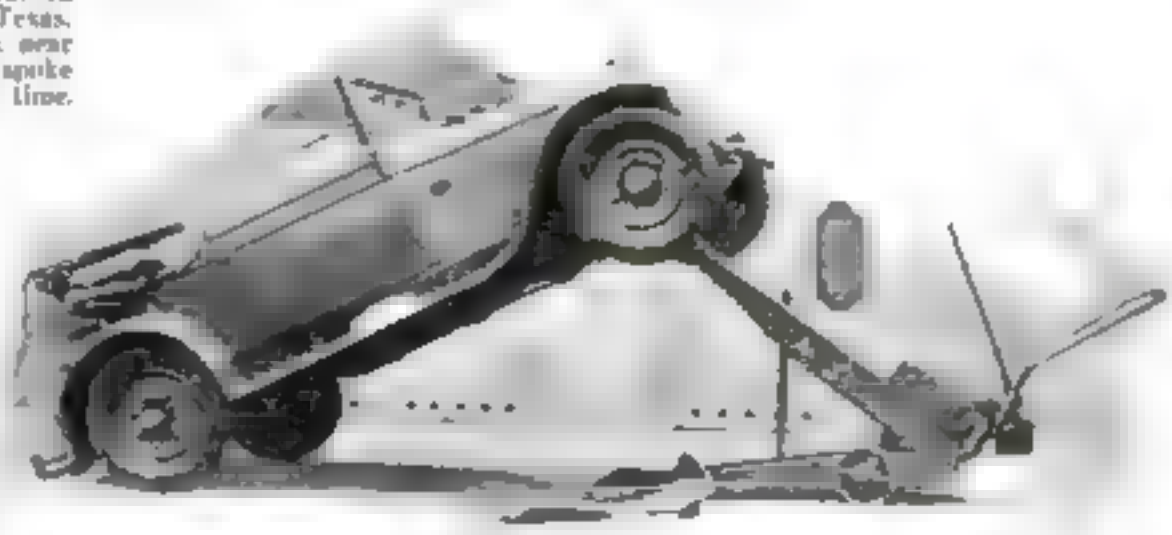




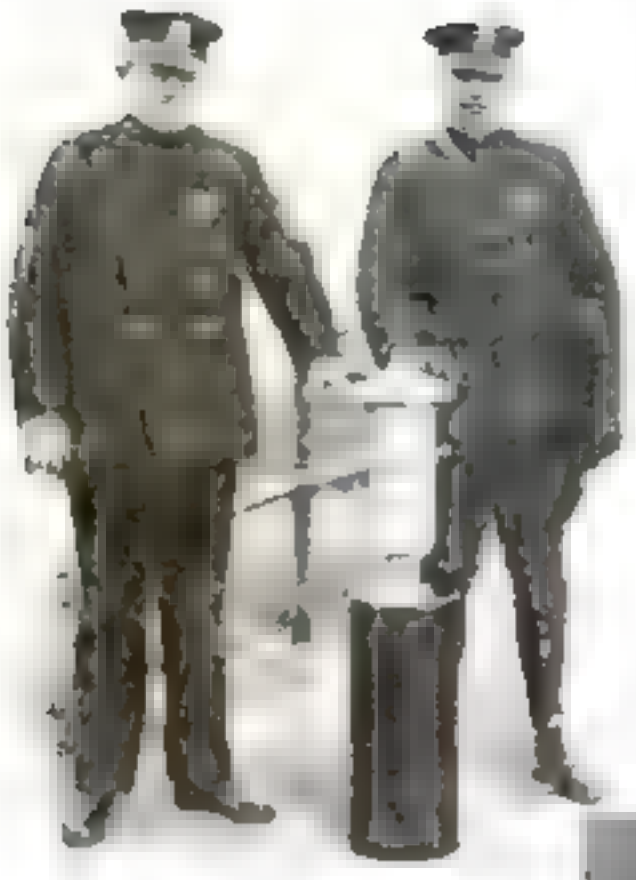
SPRINGS FOR CAR WHEELS. Shocks that jar wheel and chassis are said to be cushioned by these spokes of curved spring steel invented by W. E. Weaver of Houston, Texas. Inset shows a close-up of the wheel with the key-block near the hub, which make it possible to replace a broken spoke without dismantling the entire wheel, thus saving much time.



CAR COOKS YOUR DINNER. A portable kitchen, consisting of two hollow cylinders, can be bolted to the exhaust manifold under the hood of a car, and almost anything you wish cooked in them, exhaust gases furnishing the heat.



NEW AUTO JACK HAS GREAT POWER. Working the handle of this German-invented auto jack raises one end of a car high in the air, exposing the bottom of the chassis for inspection or repair. Hydraulic pressure works the strong cranelike arm of the jack.



AUTOMATIC WHISTLE WARNS MOTORISTS

BEFORE the traffic lights change at a certain corner in Scotia, near Schenectady, N. Y., there is a shrill whistle from an owl-looking automatic policeman on the adjacent sidewalk. Within the contrivance there is a regulation police whistle which is sounded by a strong blast of air created when the piston of a cylinder is suddenly released by a magnetic coil.

The device is electrically controlled, either by hand or automatically like the usual traffic lights. It should prove useful at locations where no "live" traffic cop is stationed to stop motorists.

CLOSING BOOK PUTS MARKER IN PLACE

WHEN this automatic bookmark consisting of hinged levers and two connected plates, is clipped to the book you are reading, it is impossible for you to lose your place. Closing the volume folds the metal arm of the bookmark between the leaves and the book will open again at once to the same page. With this device it is unnecessary to damage a book by turning down the corner of a page or leaving the [illegible] when the book is closed.

Clamped to the back of any book, this device automatically inserts the plates as a marker.

MIRRORS CAST IMAGE ON SCREEN BEHIND SPEAKER

LECTURERS can operate a projector equipped with a new mirror attachment from their desks, inserting and changing slides at will while facing the audience. The attachment fits any standard projection machine or can be secured as part of a complete projection unit. It uses two mirrors to cast the image on the screen which is above and behind the speaker.

Objects within a picture can be pointed out with a pencil directly on the slide in the machine. The projector throws an enlarged image of the pencil on the screen.

This instrument does away with the necessity of placing the projector in the back of the room and having an assistant insert the slides while the lecturer remains in front facing the audience. Delays incident to changing slides are avoided.

With double mirrors, this picture projector throws an image on screen behind the lecturer so he can face audience.

AUTOS, OUSTING HORSES, BANISH LOCKJAW

IN THE PAST ten years, the spread of the automobile has practically banished lockjaw. This apparently curious fact is easily explained, according to Dr. C. O. Sappington of the National Safety Council.

The digestive system of horses is the normal breeding place for lockjaw germs. At one time when horses were common lockjaw germs were scattered by billions in the soil and dust. Any chance human injury, whether a scratch from a rusty nail, a fireworks burn, or a cut from a knife was likely to allow these [illegible] enter through the skin and produce the dreaded clenching of the jaw which gave the disease its name.

Today automobiles have displaced millions of horses, and a cut or abrasion therefore is much less likely to be infected by lockjaw germs.

WORLD BLOWN UP TO STUDY GEOGRAPHY

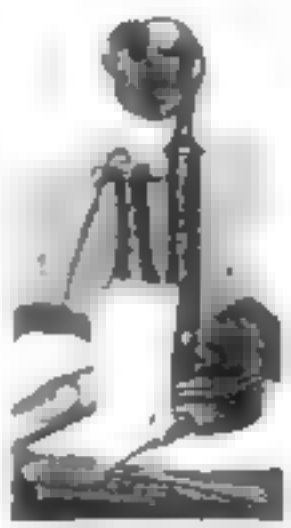
BLOWING up the world actually happens with a new collapsible rubber globe with the map of the earth on its outside surface. Inflated like a toy balloon, it is then attached to a standard for use in the study of geography. The small size to which it folds when inflated and its lightness make it easy to carry from one room to another.

MOTORS CHALLENGE FAMED GONDOLIERS

GONDOLIERS of the Italian city of Venice recently had a narrow escape from oblivion. In a close vote, the Gondoliers' Association defeated the municipal government's project to banish gondolas entirely from the canals, which serve as streets, and substitute speedy taxi motorboats. However gondoliers must compete henceforth with the growing number of motor craft recently augmented by government order.

NEW PHONE BASE HAS DRAWER FOR INDEX

WHEN a new attachment for the telephone, a small circular base is added to the instrument, finding a phone number becomes easy. A drawer slides out and reveals an alphabetically arranged index, where frequently-called numbers are listed. The attachment does not interfere with the use of the desk telephone.



With phone on this index-bound [illegible] base numbers are handy.

FLY IS BRED TO KILL THE PEACH PEST WHICH ATTACKS AMERICAN TREES

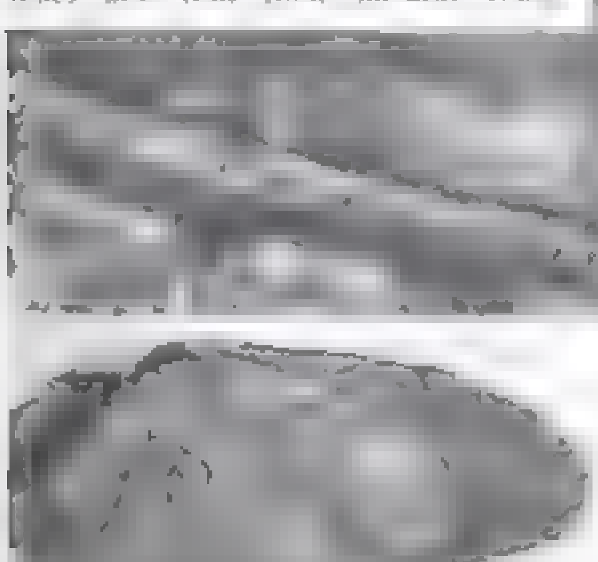
[illegible] white discs hanging from fruit orchards are not to be mistaken for some relic of old superstition but are being used at present in the war against the oriental peach moth, an insect pest that has done extensive damage to peach trees throughout the United States.

Dr. [illegible] Garman and John Schread of the Connecticut Agricultural Experimental Station, have perfected a means of combating the menace. Their weapon is another moth, the *Trichogramma minutum* egg parasite, a deadly enemy of the oriental peach moth.

In their Connecticut laborat[illegible] [illegible] A device resembling a vacuum cleaner is used to collect the food for the parasite. About ten thousand of the parasi[illegible] paper disc [illegible] eter. These discs are [illegible] eggs in the fruit orchard are destroyed by the parasites as they emerge from the discs and find their natural food.

"MIKE" SHOWS CRICKET FINE MUSICIAN

[illegible] apparatus is seen at left and the [illegible] cage and microphone inside the booth



The upper picture shows the cricket's musical instrument and the lower picture shows the under side of the [illegible] wing. Rubbing the wings together makes its high pitched song

[illegible] been revealed by sound movies of the cricket, taken under the direction of Dr. Frank E. Lutz, of the American Museum of Natural History, New York.

The music is played five octaves above middle C of the ordinary piano keyboard. It is impossible for the human violinist to reproduce these high notes.

To make the cricket talkie, a wire cage containing the cricket, and a microphone were placed in a sound-proof booth. A movie camera was set up outside the booth and focused on the cricket. A recording unit connected with the microphone caught the music.

Odd Rules Hamper Our Cars Abroad

On mountain road and desert trail, the American-built car is now [illegible]

In South America cars must be equipped with [illegible]

Disk Wheels, Safe Headlights, and Electric Horns Banned in Far Places; Why a Jap Won't Ride in a Yellow Automobile

By GEORGE LEE DOWD, Jr

PLACE your finger at random on a map of the world. Whether it touches Afghanistan or Madagascar, Patagonia or the Fiji Islands, the chances are that American motor cars are familiar to the people who inhabit the spot. Automobiles from the factories of the United States have penetrated to the outposts of civilization. Last year, more than half a million of them were exported. Vessels that plow the seven seas carry in their holds American cars destined for all parts of the world.

In each foreign country where the exporter introduces his machine, he must take into consideration the customs, beliefs, and peculiar laws of the community. In the New York office of the General Motors Export Company, which ships many makes of American cars to foreign lands, several score "do's and don'ts" for selling cars abroad have been collected. They indicate the unusual conditions that have to be met in the auto markets of the far corners of the globe. They are catalogued under the heading: "Unusual Sales Resistance."

One division, for example, is "Color." When a manufacturer paints his machines for foreign delivery, he has to watch his step.

A few years ago a sales manager thought he would boost sales in a South American country by sending down a special sport roadster with de luxe equipment. Resplendent in a coat of brilliant red paint, it started on its way. A few days after it arrived, a frantic cable raced north from the branch manager in the southern country. Not only was it impossible to sell the car, he reported, but he couldn't even drive it on the streets. A law in that country prohibited any automobile from being painted red. That color was reserved especially for fire engines. The only thing that could be done with the roadster, unless it were completely repainted, was to sell it to the fire department!

Japan is another country where red automobiles are on the "Not Wanted" list. Here the reason is the popular antagonism to the Russian Reds and everything suggestive of them. Also in

In parts of Norway, motorists are delayed by laws that send traffic up in the morning and down in the afternoon

"The Land of the Rising Sun" it is illegal for a private citizen to own a maroon colored car. That shade is reserved by law for the exclusive use of the Mikado and the royal family. Consequently, a motor car manufacturer who sent a maroon auto to Japan would find a limited market.

Other Asiatic countries also have decided color preferences which must be remembered. In many parts of India, for instance, green is thought to bring bad luck. It is the color of Yama, the Hindu Satan. So nobody wants a green automobile. In other sections of the same country, black is considered a potent bringer of misfortune and motor cars that are painted in that shade go begging.

Natives are always willing to help a motorist across a river in Africa. Cars for that region carry ropes, ready for any emergency

Hard going but this auto got through. Driving along a main road overgrown with elephant grass after rainy season.

In China, the color of mourning is exactly the reverse of that used in America. Instead of black, it is white. Consequently, those in the market for automobiles in China shy away from machines painted white. That color is reserved for the dead. In Japan, "Yellow Cabs" would have small popularity and autos of that hue are not wanted. For there yellow instead of black or white is the mourning color.

But color is not the only thing that the automobile manufacturer, who has an eye on foreign markets, must keep in mind; there are many other things as well.

When four-wheel brakes came into vogue, one American concern sent a shipment of cars to England.

"They can't be sold until they have a red triangle painted on the back," the dealer was told. This law is still in effect. All four-wheel-brake machines in Great Britain must carry such an insignia to warn motorists behind that they may come to a sudden stop.

Another safety measure that has caused American auto makers considerable inconvenience is in force in Japan. No automobile there can be equipped so the driver can turn on his headlights and tail-light from a single switch on the dashboard. A separate switch must be provided on the tail-light so the driver has to get out and go around to the back of his machine to operate it. Then he is sure his tail-light is on.

Mud-splash guards are also necessary in Japan. These are rubber aprons which the driver is required to fasten to frames outside the wheels as soon as it begins to rain. They keep pedestrians from being splashed by passing cars.

BEFORE you can sell a taxicab in Japan you must put two horns on it. One isn't enough. An electric horn and a bulb horn are required on every machine, so, if one fails, the other will still be in commission. Another regulation provides that there be two people running every taxicab, a driver and a helper. As the helper has little to do except man the auxiliary horn, Japanese taxis frequently dash through crowded streets with both horns going full blast. Eighty percent of all automobiles in Japan are taxis, so the honking is practically continuous.

In France, Poland, and several South American countries, the electric horn, standard on American cars, is outlawed entirely. Only bulb horns can be installed.

Motorists in some tropical countries refuse to accept disk wheels. The reason is that they are in the habit of tying ropes around the rims and tires to help them get out of deep mudholes. Other drivers, in the same countries, ask for the disk wheels because they believe wooden wheels swell and warp during the rainy season.

Travel in far-off countries is just one automobile after another. Even in the frozen wastes of Russia, the picturesque sled and horse is giving way to the American built and imported cars.

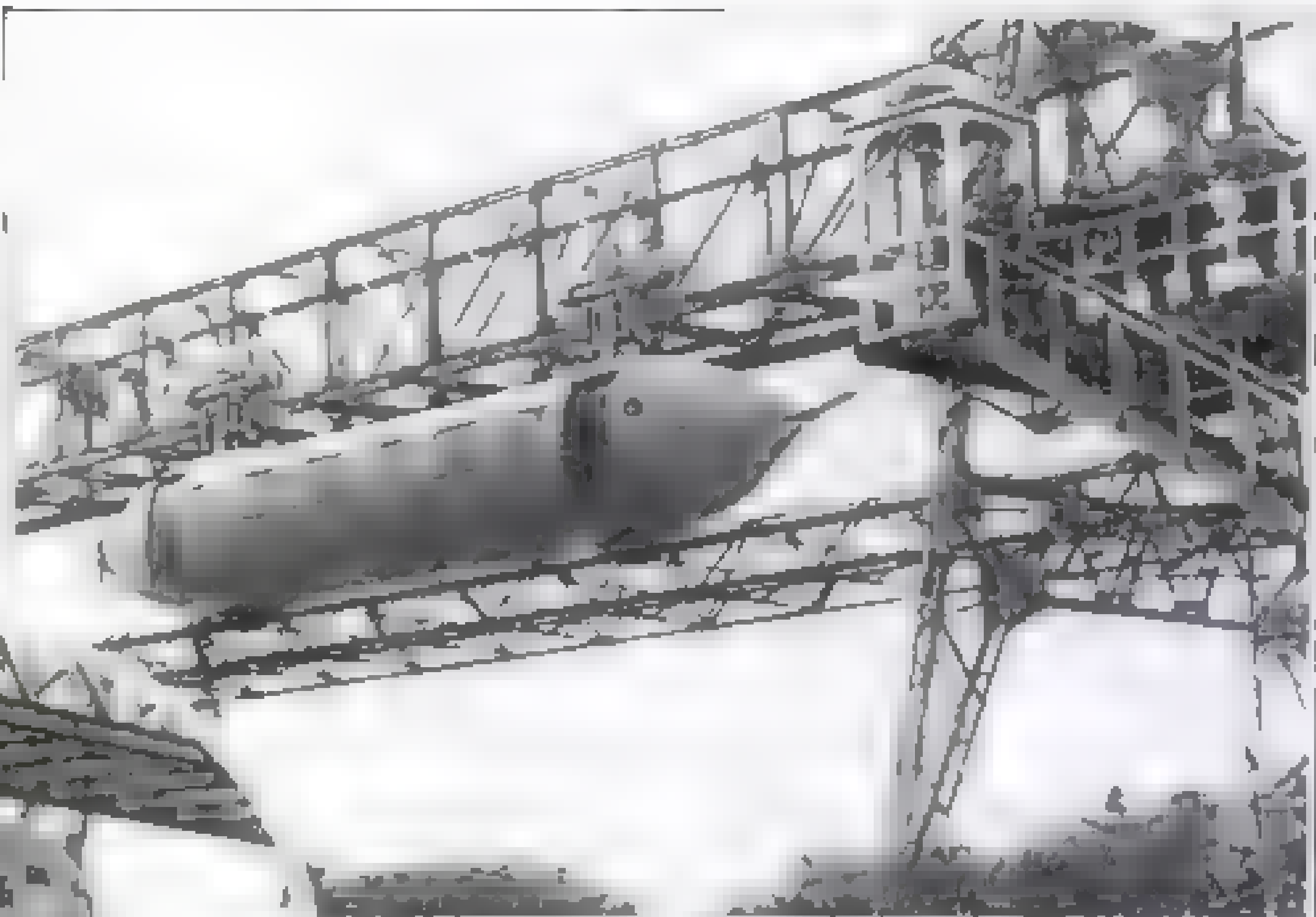
OFTEN, the season of tropical downpours has an important bearing upon the equipment that a dealer must install on his cars to make them sell.

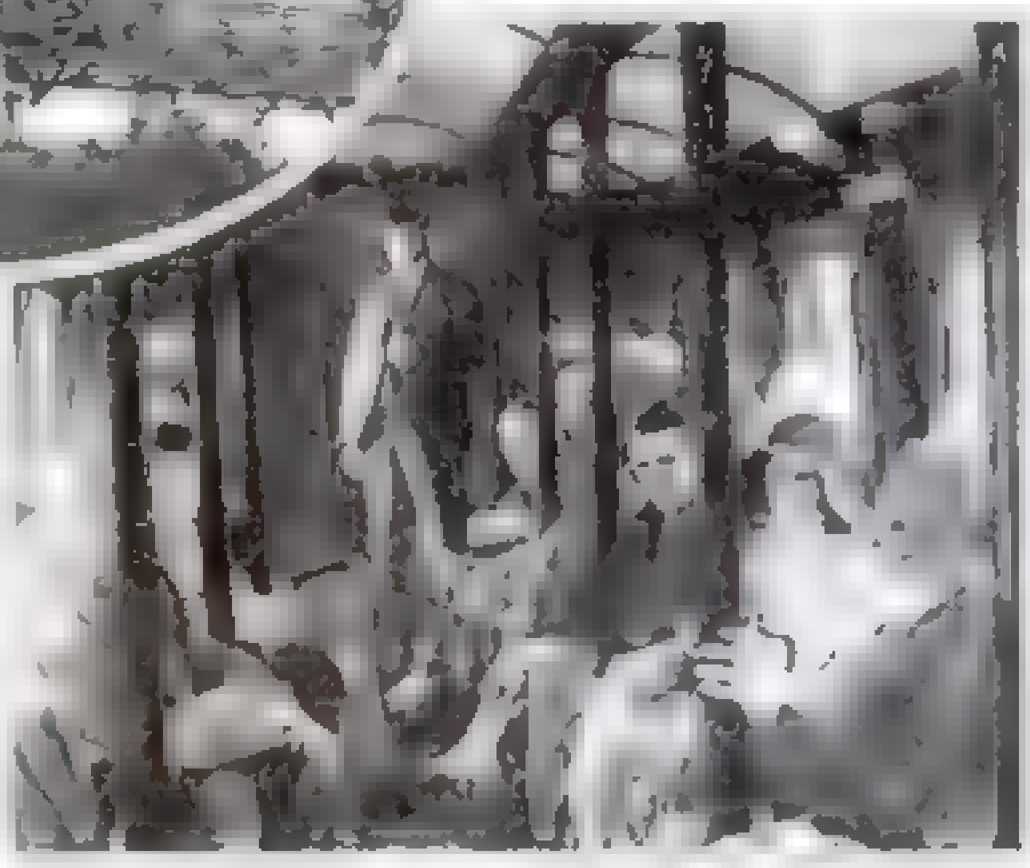
In Porto Rico and Venezuela machi[illegible] frequently have to be fitted with stan[illegible] pipes on the air intake of the carburet[illegible] so the owners can drive through swoll[illegible] streams. Thus equipped, the automob[illegible] with distributors placed high, can [illegible] driven through water so deep that [illegible] driver's seat gets wet.

One salesman, in delivering car[illegible] tropical country, had to plunge [illegible] stream whose current was so [illegible] the water (Continued on p[illegible]

Monorail Aims at High Speed

Streamlined cars on an overhead railway may whiz across country at 150 miles an hour—Offers new system of travel for interurban commuters





A dozen passengers rode in the experimental one-rail hanging car when it made a trial trip. Bennie, the inventor, stands in the doorway

STREAMLINED cars—vehicles resembling an airplane fuselage with [illegible] whiz at 150 miles an hour along a new kind of overhead [illegible] way. Engineers who attended a [illegible] Transport Congress in Glasgow, Scotland, saw [illegible] of the cars to be built run along a short section of skeleton structure of steel near the Scotch city of Milngavie. Although the section of experimental track was too short to test the car's maximum speed, two air propellers pulled the car at a good clip with more than a dozen passengers aboard.

The inventor, George Bennie, declares that double-track railroads of this kind would be ideal for superspeed commuting service between cities and suburbs. An overhead railway could be operated through a congested district without disturbing traffic. Building the towers and track would cost much less than a subway, and the small amount of structural work for a monorail track, such as Bennie's cars use, would cut off less sunlight than an ordinary elevated railroad.

[illegible] are suspended on rollers from [illegible] overhead rail, with a guide rail [illegible] keep them from swaying. Air-[illegible] propellers at the front and rear are run by electric motors, which take their current from the rails. The combination of streamline and air propulsion is expected to give the cars great speed.

Few people realize, Bennie points out, that although no cars like his have ever been built before, the idea of an overhead monorail line is not new. Such a railroad has been in operation for twenty-seven years over the nine-mile distance between Barmen and Elberfeld, in Germany, and in that time it has carried more than 700,000,000 passengers without accident. This suspended monorail line uses cars shaped like those of present-day elevated railroads, either singly or in trains, all hung from a single overhead rail on an arched trestle above the streets. They are driven by electric motors [illegible] the wheels [illegible] along the rail.

At this [illegible] New York City [illegible] are [illegible] to build [illegible] suspended monorail line on which 200-horsepower cars would run at forty-five miles an hour [illegible] the outlying borough.

A glance at their history shows that only by taking to the air have monorail lines succeeded. America was to have a monorail road as long ago as 1910, when a single-rail line was built to connect City Island, N. Y., with the main line of the New Haven Ra[illegible] New York City [illegible] overhead guide [illegible] steady the car, proved insufficient and it jumped the track and was wrecked.

One of the most promising of monorail cars was the amazing vehicle developed by Louis Brennan, British inventor, which needed no extra rail to balance it, as it ran along a single rail on the ground. A gyroscope kept it upright with forty passengers aboard, in apparent defiance of the laws of gravity. However, it never came into commercial use. Another experiment was a short monorail line near Ballybunnion, in Ireland, where odd-shaped cars were drawn by a steam locomotive along a monorail track raised a few feet above the ground on an A-shaped trestle. Built in two parts, they straddled the rail for balance. Today, however, except for a few short lines at mines and quarries, the aerial monorail alone survives.

TWO ALONE BUILD STONE HOME

All the cement that went into Ernest M. Belanger's home, at Arlington, Mass., was mixed by his wife as seen in photo above

Six years were spent by the post office clerk and his wife in building this house of age-old stones.

For six years Ernest M. Belanger of Arlington, Mass., and his wife gathered thousands of stones from nearby fields, and with them reared the walls of their "dream house," a remarkable modern home built entirely by the couple in their spare time. Working as a government mail clerk at night, Belanger devoted his available hours of daylight to playing the dual rôle of architect and contractor. The twenty tons of cement which went into the walls of the completed house were mixed by his wife.

A geologist might note that the stones used belonged to the Ice Age. In that frigid era a thick blanket of stones was spread over New England. Such ice-dropped stones went into the walls of the post office clerk's home, so this material cost only the effort of gathering.

CHICAGO TO HAVE FIRST ALL-METAL APARTMENT

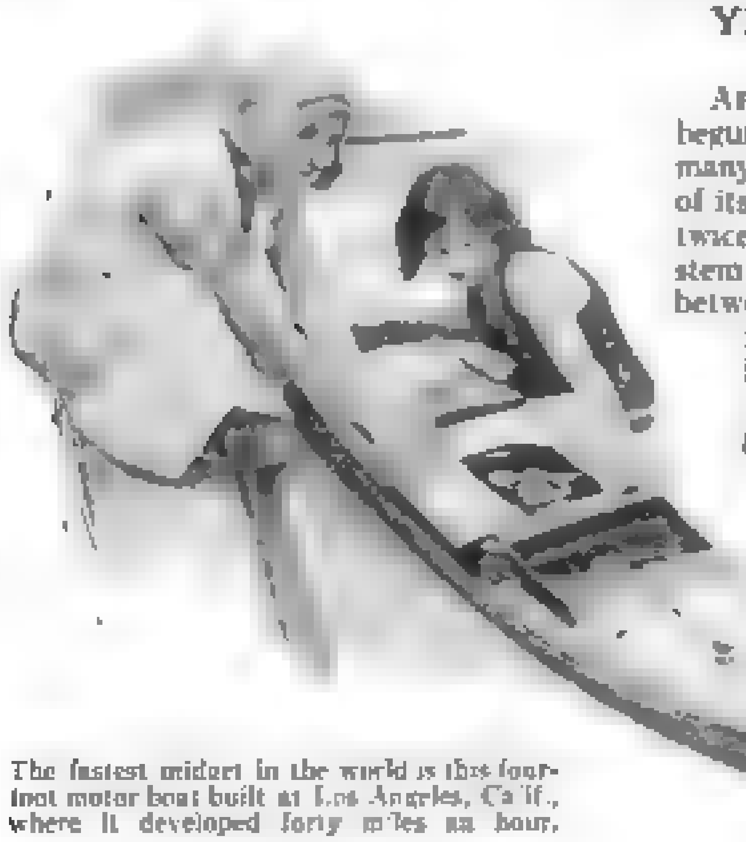
What is said to be the first all-metal apartment building is soon to rise in Chicago. Its walls will be faced, on the outside, with a gleaming silver-colored alloy of chromium and aluminum. When a layer of rock-wool insulation is added, the outside walls, only three and a half inches thick, are expected to be as retentive of heat as walls of brick. The seventeen-story building will have long "modernistic" window panels of glass and will be warmed electrically. Its metal finish is similar to that on the shiny spire of New York's new Chrysler Building.

The thin metal walls of the Chicago apartment increase the rentable floor space by fourteen percent.

FOUR-FOOT BOAT HITS FORTY-MILE CLIP

A model speedboat, four feet long, that can keep pace with its thirty-foot elders, recently cleaved the spray at forty miles an hour in a demonstration at Los Angeles, Calif. The remarkable little water runabout is reputed to be the fastest motorboat of its size ever built. It is powered by a steam motor equipped with flash boilers, which convert water into steam instantaneously at high pressure.

The handsome model is almost an exact reproduction of the larger craft whose design it imitates, having complete trimmings ranging from port and starboard sidelights to ventilators.

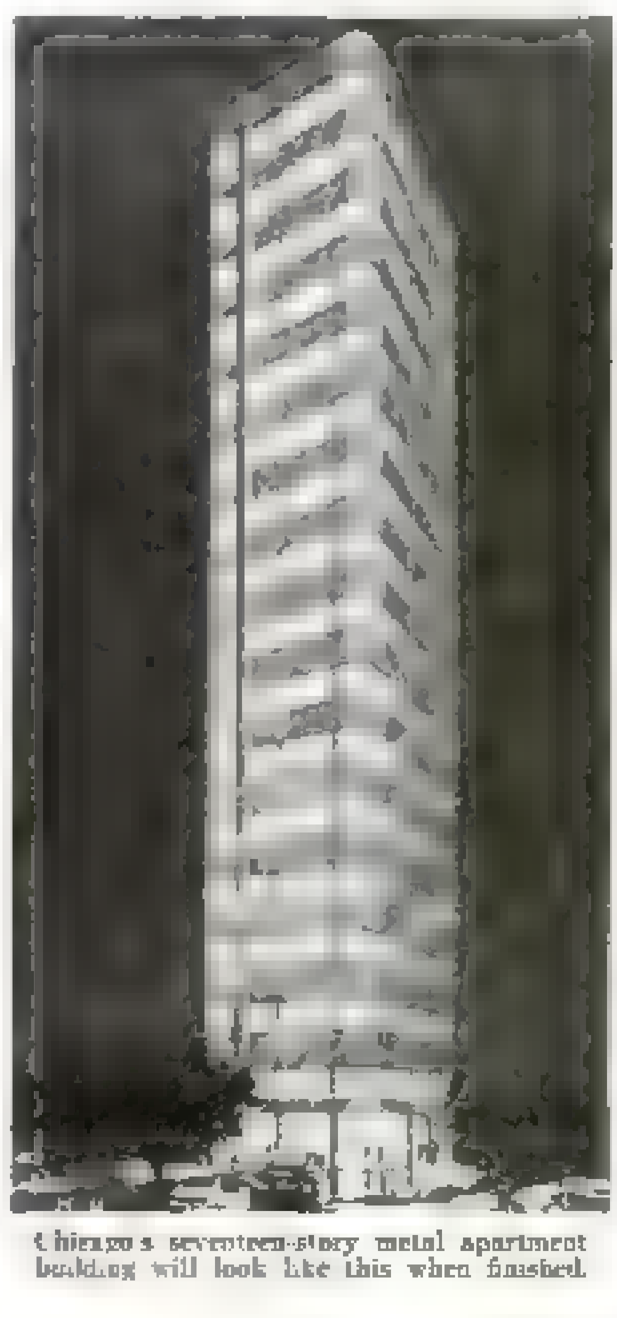


The fastest midget in the world is this four-foot motor boat built at Los Angeles, Calif., where it developed forty miles an hour.

BOULDER DAM, BIGGEST YET, NOW UNDER WAY

After years of discussion, work has begun on the Boulder Dam project—in many ways the mightiest engineering feat of its kind ever undertaken. A dam nearly twice as high as any now in existence will stem the Colorado River at the boundary between Arizona and Nevada. The artificial lake it creates is so large that it will take three to five years to fill. From it, water will flow through irrigation canals into the Imperial Valley. The entire cost of the project is expected to be repaid by electricity from a million-horsepower hydroelectric plant.

It will be months before the construction of the dam proper actually begins. The job is expected to be completed in seven years.



Chicago's seventeen-story metal apartment building will look like this when finished.

POISON GAS TANK KILLS BOLL WEEVIL

All ready to destroy the boll weevil. This carload of cotton seed packed in the circular tank will be [illegible] vacuum pressure when [illegible] door [illegible] sealed and air is pumped out

Vacuum cleaning for the cotton crop in areas infested with the boll weevil, cotton's greatest pest, has been found to be the surest method of destroying the harmful insect.

A carload of cotton seed is packed into a circular metal container or tank. This tank is eighteen feet long and five feet in diameter. When the tank door is closed a vacuum is created. This vacuum removes all air from the pores in the seeds. Hydrocyanic gas is then shot into the tank and permeates the seeds, killing all insect pests that may be within without doing the slightest harm to the seed itself.

Vacuum fumigation, using different pressure units and gases, is being tested for the preservation of meats, furs, drugs, grains and some foodstuffs. Citrus growers are also using this process with success to rid their stock of scale. The heavily infected boll weevil districts, however, are making the greatest use of the new method, under governmental supervision, in a determined effort to wipe out the destructive pest that has cost the cotton belt millions of dollars.

PINS IN BOOK PACKAGE ARE EASY TO CARRY

Books of pins, similar in form to the book matches in common use, are a handy and convenient new way of carrying pins in the pocket or handbag.

The pins are inserted in stiff paper, three leaves of which are contained in the cardboard cover. The cover folds over and catches under the stub, which holds it when the package is closed.

GAS SMELL NOW SAVED

Makers of gasoline now have found a way to use even the smell. They make it into bottled gas, for fuel and light. The gas is liquefied and bottled under pressure and now refiners are purchasing compressors and tanks to capture and store the formerly despised "stink."

NO ACCIDENTS WITH NEW HARROW-PLOW

Combining a harrow and plow, a new farm implement, tractor powered, does two jobs at once. The pulverizing attachment, driven by a shaft from the motor, levels the furrow behind the plow and leaves the field ready for seeding. Its drive shaft has a joint that automatically releases it from the tractor when any object like a big stone or a stump is encountered. This is designed to prevent accidents to the driver and the machine—serious injuries resulting in the past when a tractor keeled over backward, catching the driver.

The plow also is hooked to the tractor by a patented connection. If the share strikes a root or a stone through or over which it cannot pass, the connecting rod buckles at a springed joint and the hook is freed from the motor. This plow-harrow is being widely used in the corn belt.

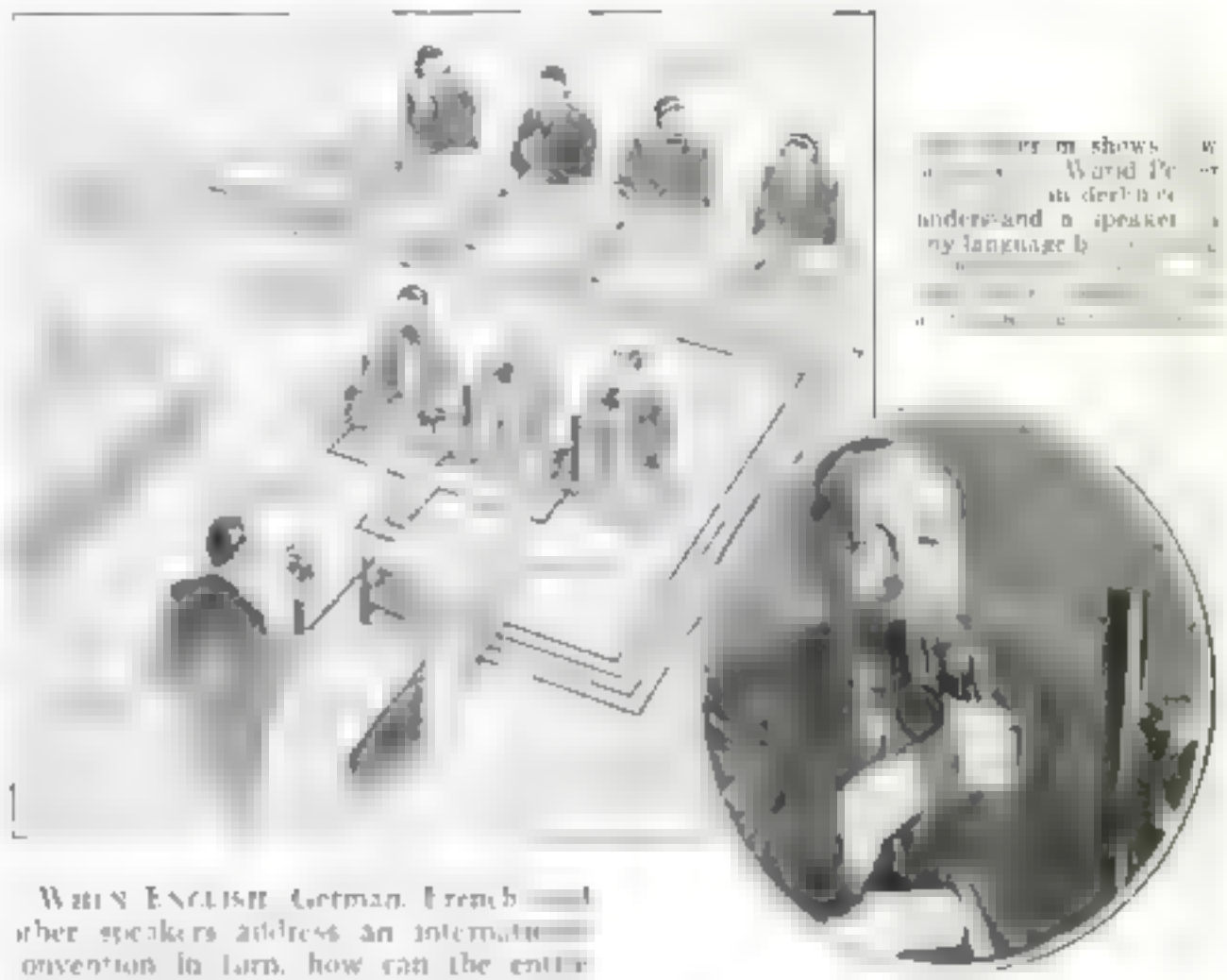
Above, the powered plow and pulverizer that do two jobs at once and leave the field ready [illegible]g. At left, a good view of the p[illegible] in the coupling rod that attaches the plow to the m[illegible] is met, the rod buckles at the [illegible] hook jumps out of the ring, freeing the plow

MILE-HIGH SKYSCRAPER WOULD EQUAL ANT HILL

The photo above shows a hill constructed by termites or white ants in Western Australia. As the ant is only a quarter of an inch long, it builds an edifice 960 times its own length. The Chrysler Building in New York, highest man-made structure is 1,046 feet high. If you allow six feet as the height of man, he is building about 170 times his own height. If he built, as the ant does, 960 times his height, his building would be more than a mile tall

The ants cement their wedge shaped skyscrapers with a salivary fluid

BABEL OF TONGUES SORTED BY PHONE



When English, German, French and other speakers address an international convention in turn, how can the entire audience understand what they are saying? The illustrations show the ingenious way in which this question was answered at a recent World Power Conference held in Berlin, Germany

Each of the audience was provided with a pair of headphones and a four-way electric switch. By turning the switch he could "tune in" to listen to either the speaker or any one of three interpreters.

Suppose, for example, that a Spanish delegate was speaking. His voice, picked up by a microphone and amplified, was carried directly to all the Spanish-speaking audience over one of the four electric circuits

At a nearby table, three quick-witted interpreters were listening to the speaker and translating his speech word by word into German, French, and English respectively They spoke into microphones with special "whispering" mouthpieces, designed to keep them from interfering with each other. The German, French and English translations, also amplified, went out on the other three separate electric circuits to the members of the audience who spoke those tongues. An electric-lighted signboard near the speaker showed at all times what translations were available, depending on the number of interpreters on duty.

HEAT CONTROL SAVES SOLDERING IRON

A new heat control for electric soldering irons enables the user to operate the iron at any desired heat. In the new device, a metal box contains an apparatus which regulates the electric current passed into the iron's heating element, in much the same fashion as attachments are used on electric light bulbs to dim the light. On the panel of this box, a three-position snap-switch and a heat control knob are placed. To start heating the iron the snap-switch is turned to the first position, applying full voltage on the electric soldering iron

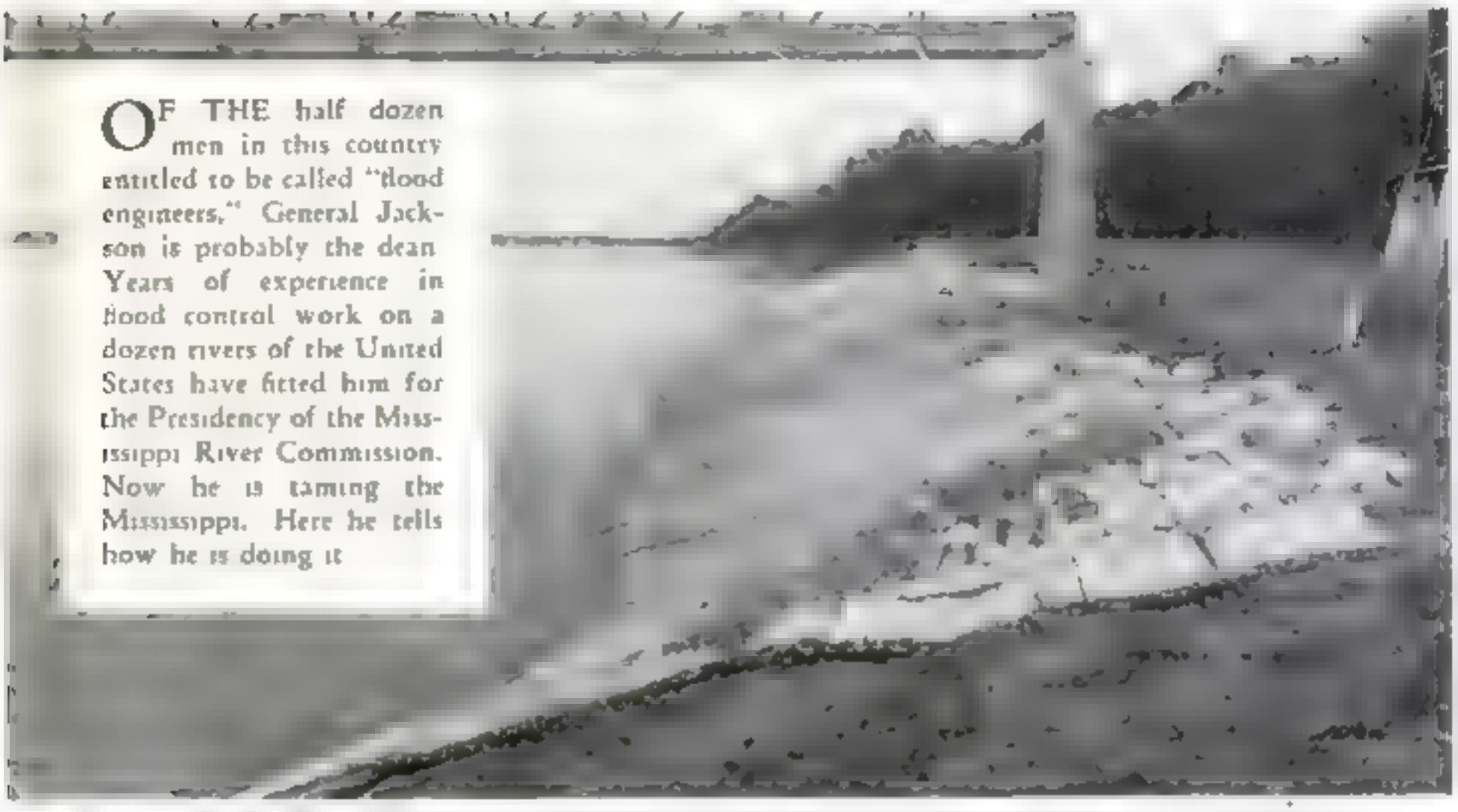
Once the iron is hot the switch is snapped to the second position where the heat control knob permits the user to

Switches control the heating iron in much the same way bulbs are dimmed. At right, the switch a heat control knob with the warning

BLAME NEW TINY GERM FOR CREEPING PARALYSIS

What are said to be the smallest disease germs ever seen by human eye have just been seen in a laboratory of the Westminster Hospital, London, England They are so small that they can ooze through the pores of solid porcelain, and were discovered only when they were magnified 1,800 times under the special lighting of an ultra-microscope

The new germs, according to Dr Foster Kennedy of the Cornell University Medical School, who visited the London laboratory, may be the cause of "creeping paralysis," otherwise known as multiple sclerosis This disease, not uncommon in America, affects particularly blond, blue-eyed persons, and is characterized by growing inability to walk. If the discovery is confirmed, a serum to fight it may at last be prepared and the disease conquered.



OF THE half dozen men in this country entitled to be called "flood engineers," General Jackson is probably the dean Years of experience in flood control work on a dozen rivers of the United States have fitted him for the Presidency of the Mississippi River Commission. Now he is taming the Mississippi. Here he tells how he is doing it

To keep the Mississippi from eating away its own banks, concrete slabs like these seen here are laid from the river bed t - h high-water mark

We Have Found a Way to End Mississippi Floods

By BRIG. GEN. T. H. JACKSON, U. S. A.

A NEW season of Mississippi flood control has begun

All along the kinkiest of rivers, from Cairo, Ill., to the Gulf steam shovels are swinging into action. With high water past, we can work the drag lines that scoop up dirt for the great new levees. Construction gangs are laying concrete mats along the curves of the river where it eats its banks. Monster machines that bite up six or eight cubic yards at a single mouthful are clanking We re taming Old Man River

Two years of work completed. Eight more remaining. Then we shall have finished the biggest dirt-moving job in history And the terror of Mississippi floods, we believe will be a thing of the past

What has that to do with the man who lives far from the Mississippi region? It may not at first seem to concern him personally that we are saving thousands of acres of farm lands from inundation, and safeguarding the lives of the people on them. But there is a good reason why it should concern him—he is paying for it Since Congress decided the $320,000,000 job was one for the whole country to shoulder, it is being paid for out of the Federal treasury to which every taxpayer contributes. It is the greatest gift that any nation has ever made to a portion of its people. Let us see how this money is being spent

First, get an imaginary aerial view of the Mississippi region. Beneath you the wide, muddy Mississippi winds through a fertile valley. At once your eye detects something unusual about this river back of its banks

On each side the land slopes downward Ten to fifteen miles from the river's banks it may be fifteen or twenty feet below the bank level. The Mississippi itself has built up those banks, higher than the surrounding country, with the silt and sand that it carries. That is the start of our whole trouble

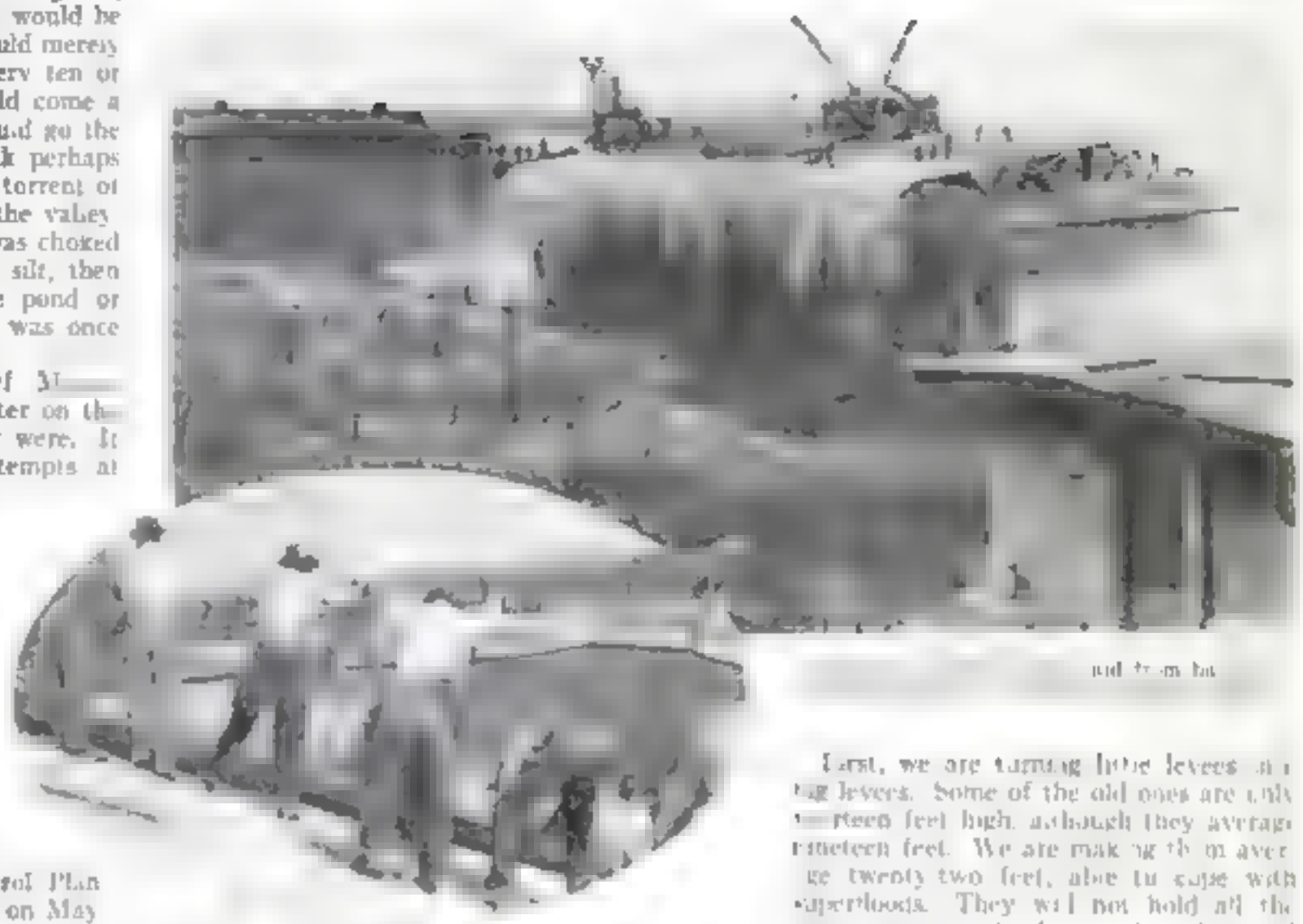
AS EARLY as January we look for signs of a flood. By the end of February, it may reach flood height at the upper end of the river. Then the water level goes up all along the way. When it reaches the top of the natural banks, it overflows them—only by a few inches, but enough to inundate thousands of square miles of low country

So our predecessors decided to fix that. They built levees, or earth dikes, all along the river and only made matters worse They tried to pen up a river that squirms and slashes like some giant fire hose by crowding it into a narrower space than

This map gives a clear idea of the work to be done by floodways in saving life and property

would hold it. For a few years, perhaps, the Mississippi would be docile enough, but it would merely be biding its time. Every ten or twelve years along would come a big flood, and away would go the levees. Through a break perhaps as wide as 3,500 feet, a torrent of water would pour into the valley. When the levee break was choked and plugged at last by silt, there would remain an azure pond or "blue hole" upon what was once farm land.

Despite popular belief Mississippi floods are no greater on the average than they ever were. It is the unsuccessful attempts at confining the river that make the damage all the worse when a levee breaks. A vivid example is the flood of 1927, the worst in the fifty years that we have kept records. Congress decided it was high time to do something to prevent similar floods in the future. The result was the present Flood Control Plan which Congress adopted on May 15, 1928.

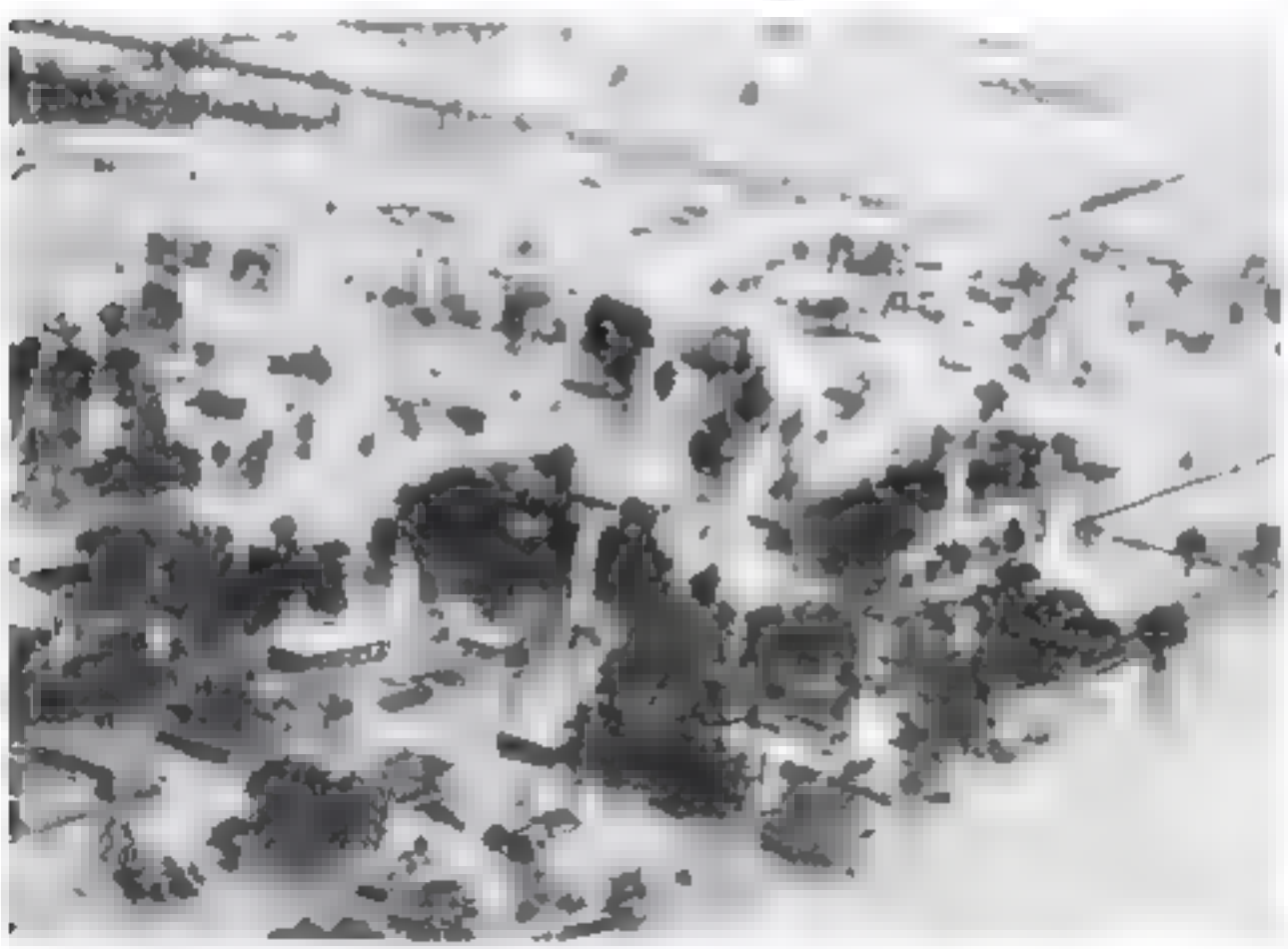


On big barges, concrete revetments are built a section at a time, then laid from shore to edge of channel

This engineering plan does not attempt to do the impossible and hold the river in one channel behind levees. Instead, it combines in one project the three things that are needed—levees to confine as much of the water as possible to its normal channel, leveed floodways to carry the rest harmlessly through other waterways, and lastly, a controlled floodway just above New Orleans to relieve dangerous flood heights at that point, by dumping flood water via Lake Pontchartrain La., into the Gulf of Mexico.

The first step in planning the system was to decide how big a flood it must be prepared to handle. Floods of any given size seem to recur in a certain cycle of years. Such a high flood as that of 1927 might be expected only once in twenty-five to forty years. The flood control system we are now building will handle a flood twenty to twenty-five percent greater, proof against a flood far worse than any ever recorded—one such as might occur *once every other century*.

The job is going ahead squarely on schedule. You could hardly put your finger down on a map of the Mississippi without striking a spot where we are working. What are we doing?



The Mississippi on a rampage. Thousands of acres are flooded and homes are washed out when the levees break, setting Old Man River free. Flood control work is to end this

First, we are turning little levees into big levees. Some of the old ones are only fifteen feet high, although they average nineteen feet. We are making them average twenty-two feet, able to cope with superfloods. They will not hold all the river water, in flood time, but they will hold a lot of it.

Everyone has heard about levees in songs and stories, but how many have any definite idea of what a levee looks like? In the first place, they are usually nowhere near the river, as so many imagine. Only about twenty miles of the 1,500 miles of levee are actually on the river bank. Most of the levees are from six to 3,800 feet back of the bankline. This gives the river room to slash around and carve away some of its bank without taking the levee along.

THE levee itself is a bank of earth—either sand, loam, or clay. To spike another misconception, it is not watertight. Water will seep right through it. We simply shape our levee so that by the time water has seeped through the back face it has sunk below ground level using the longest back slope for sand, the most permeable material. If it comes out above, it will start trouble.

The first sign of a badly leaking levee is a "boil" that appears behind it. Water comes "boiling" up in a round spot, building up a rim curiously like the geyser holes in Yellowstone Park. Some boils reach a diameter of ten feet, and last year we had one even larger than that.

At flood times, patrols go up and down the levees constantly, looking for such leaks. The instant a boil appears, we throw up a temporary dike of sandbags behind it. The water leaking through the levee forms a pond between the two walls. As soon as it becomes a few feet deep, the back pressure of water in the pond keeps any more from coming through.

Most levee failures occur when the foundation, undermined by such a leak, gives way. We had one narrow escape last year just below Greenville, Miss. Thirty or forty feet of the levee settled, but did not collapse. We dug in, after flood danger was past, to

(Continued on page 140)

PHOTOS SHOW STEPS IN GROWTH OF THE EXPENSIVE ORCHIDS

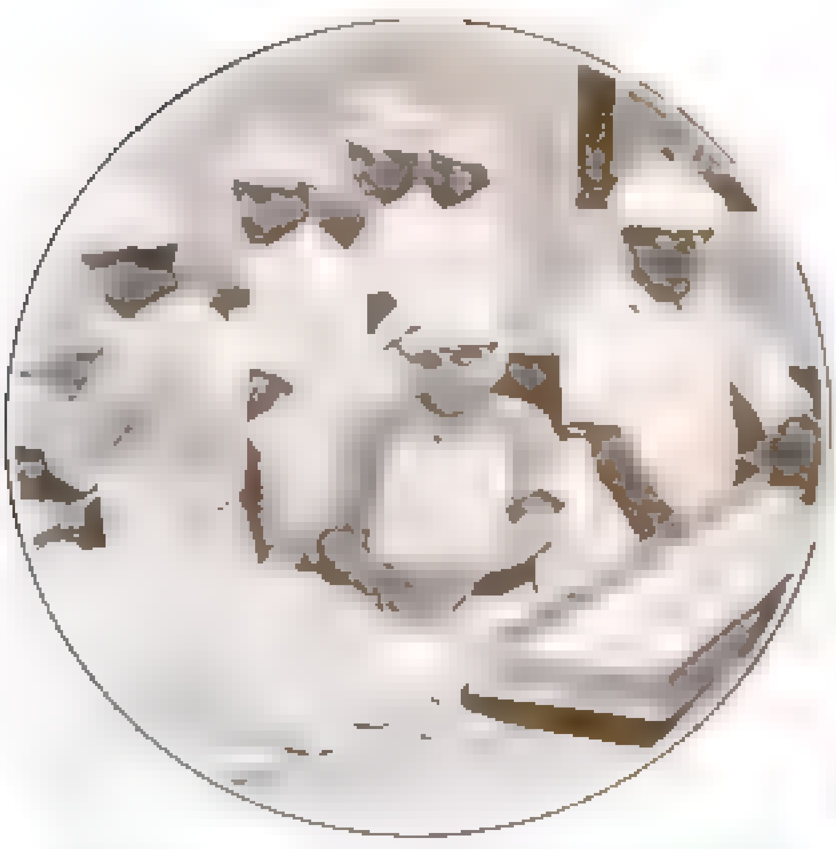
How the Staff of Life Is Made Here and in Foreign Countries

BREAD FOR THE SYRIANS. An oven is unheard of in Syria, and when bread is baked the nearest [illegible] serves as a fireplace. Rolled into thin, disk-shaped loaves, the dough is baked on the stones, which are heated by a brush fire that is always in need of fuel.

CANADA'S OUTDOOR OVEN. Near Quebec, Canada, [illegible]

MIXING DOUGH IN THE EAST. Below, [illegible] are getting ready to bake their bread. [illegible]

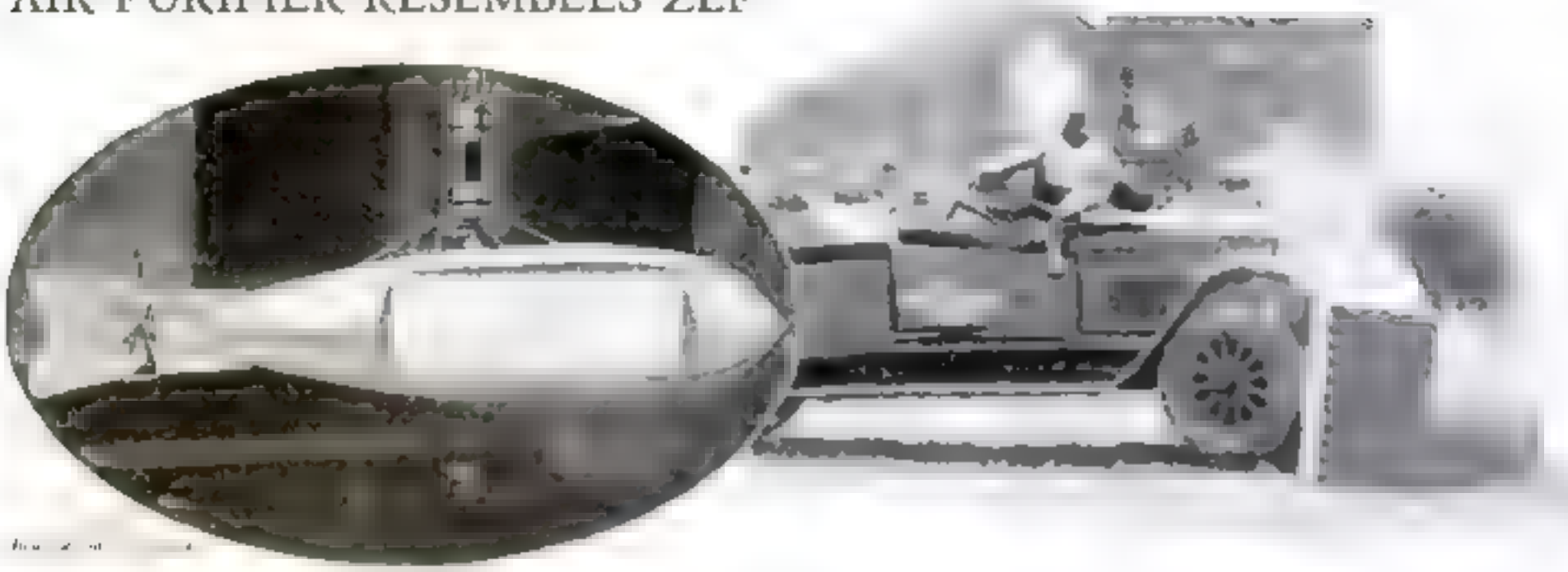
TURKS PREFER PILLOWS. The oblong loaf common in this country wouldn't suit these Turks at all. They want bread made in round, pillowlike loaves.



BIG CREW SPEEDS BAKING. Teamwork does it in the Near East, where many hands are kept busy when there's baking to do. Little oblong loaves are baked in narrow pans

MACHINERY DOES IT IN AMERICA. All the other methods illustrated on this page seem primitive by comparison with this big modern dough mixer which automatically shapes the [illegible] for baking in a large bread factory

AIR PURIFIER RESEMBLES ZEP



Perfumed disinfectant, mixed with oxygen, is sprayed by the propeller of this Zeppelin-like device to purify the air in theaters.

AIR IN theaters and other public places is now purified by a device that resembles a Zeppelin. Recently installed in the Coliseum, a London playhouse, it freshens the air during intermissions by spraying a mixture of oxygen and perfumed disinfectant

When the machine is dropped from the ceiling of the theater by a hollow cable, an electrically driven propeller sends it spinning in a circle over the heads of the audience. Oxygen supplied from outside tanks through a hollow cable is ejected and scattered by the propeller

This dirigible-like affair is illuminated with colored electric lights.

SMALL AUTO RUNS ITSELF WHEN LIGHT HITS IT

BEAMS from a lamp, held by one of its student builders, control a miniature automobile recently exhibited at the University of Illinois. It starts and stops itself, turns on its lights, and blows its own horn.

The two students, A. F Rus and J R Woodfill, decided to apply for themselves the wonders of the "electric eye" or photo-electric cell which they had learned about in classes. They installed one of these special vacuum tubes in an electric-powered model auto

To lead the car forward, a lamp is directed at the tube, which is mounted on the model's windshield. This actuates the motor and starts the car. Flashing the light twice works a selective relay that turns on the lights.

Light, striking a photo-electric cell, controls this car built by two University of Illinois students.

CRASH CAR INTO WALL IN TIRE TEST

AT A SPEED of thirty-seven miles an hour, Dick Grace, noted stunt flyer for the movies, crashed an automobile into a solid brick wall to test the blow-out resisting qualities of the tires. The force of the impact threw the driver out of the car, but he was uninjured except for slight bruises. The entire wall was moved several inches by the shock of the 3,000-pound car's impact, and the framework of the automobile was bent and twisted.

ARROW ON BIKE SHOWS RIGHT OR LEFT TURN

BICYCLES, as well as larger vehicles, may now have their safety signals. A new invention is a diminutive arrow which, mounted on the rear of the bicycle, indicates whether the cyclist is about to turn left or right. It swings in either direction at the touch of a lever on the handlebar, and at other times it lies in a vertical position. With the device is combined a small red bull's-eye that reflects the rays of automobile headlights at night

The signal arrow, which is also designed for use on motorcycles, is being used by many bicycle riders in France, where it was invented, and has prevented many accidents.

MODEL OF EIFFEL TOWER BUILT FOR RADIO MAST

A MODEL of the famous Eiffel Tower of Paris has been built by Bernard G Warr, a young English architect, for use as a radio mast. As a change from the usual pole, which he considered unsightly, Warr built his model in odd moments and completed it in six months

The structure is forty feet high. It is built entirely of wood, thin laths being used, without dependence on guy wires. As the illustration shows, the tower is strong enough to support the weight of a man without difficulty

The proportions of the French tower, which is 984 feet high, are exactly maintained throughout in the graceful model, which makes a fine radio mast.

Built entirely of thin laths, this forty-foot Eiffel Tower model serves as a private radio mast.

Pacific Ocean Now Being Carried 92 Miles Inland

Stockton, a California city, ninety-two miles from the coast, is to have the Pacific Ocean brought to its door to give it the benefits of waterway commerce. Although there is now a channel between the city and the ocean, with its outlet at San Francisco Bay, its depth of nine feet has made it impossible for sea-going vessels to ascend it. Dredging of this water route to a depth of twenty-six feet and a width of 400 feet was started recently and is expected to be completed in 1933.

A harbor is being created at the center of the Stockton business district which will be 1,200 by 800 feet in size. Monster electric dredges are moving 21,000,000 cubic yards of earth from the channel. The cost of bringing the ocean to the heart of the city will be nearly six million dollars, with the federal government providing approximately half the money. When finished ocean going ships will be able to sail right up to Stockton under their own power.

TANK TO GUARD BASE OF LONDON BUILDING

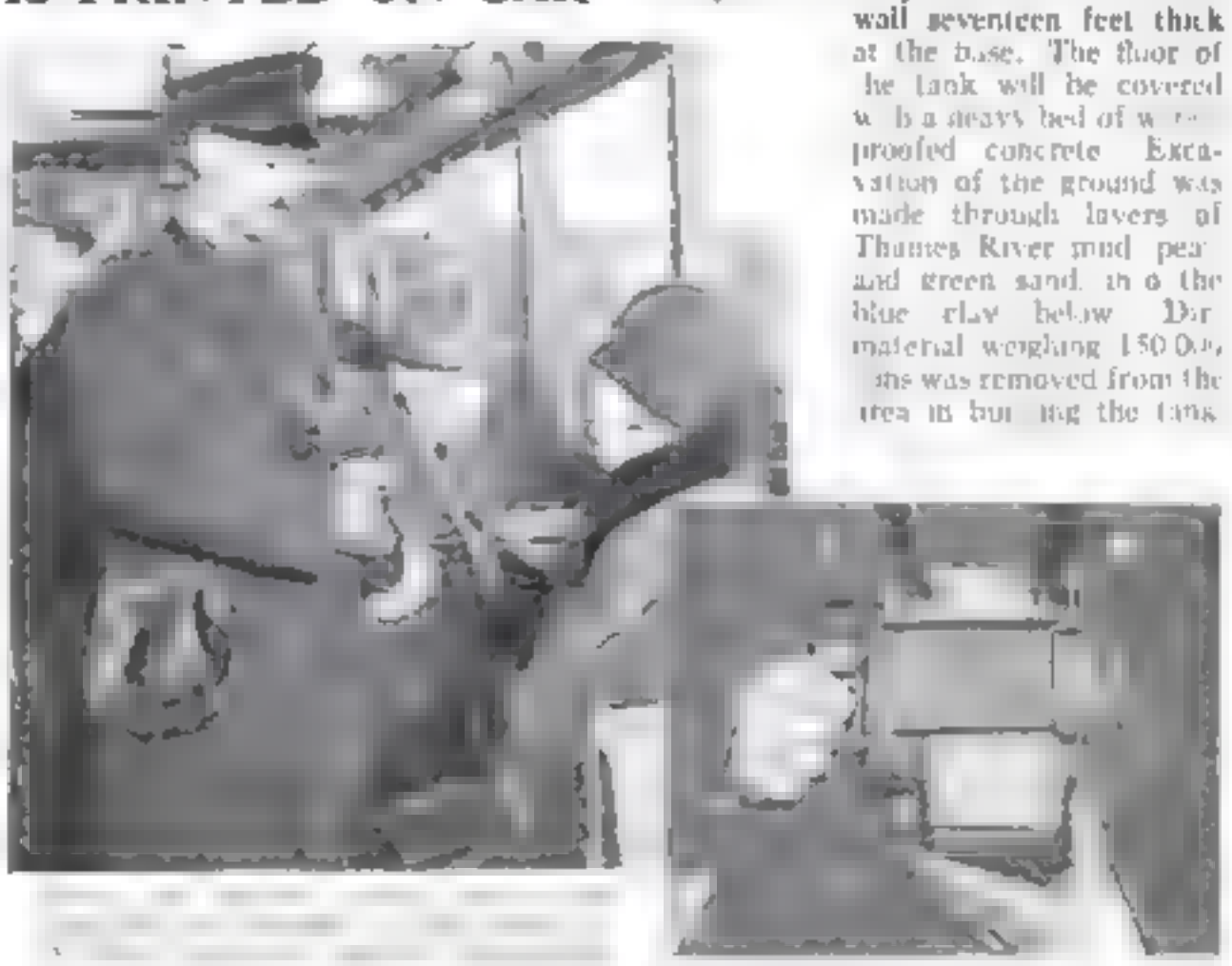
For protection against the action of tidal water and shifting soil, a new office building in London will have its foundations surrounded by a huge underground tank. It is being constructed with an outer layer of steel, within which is a brick wall nine inches thick, covered with a coating of asphalt. Finally there is a concrete wall seventeen feet thick at the base. The floor of the tank will be covered with a heavy bed of waterproofed concrete. Excavation of the ground was made through layers of Thames River mud, peat and green sand, to the blue clay below. During material weighing 150,000 tons was removed from the area in building the tank.

THIS TRANSFER SLIP IS PRINTED ON CAR

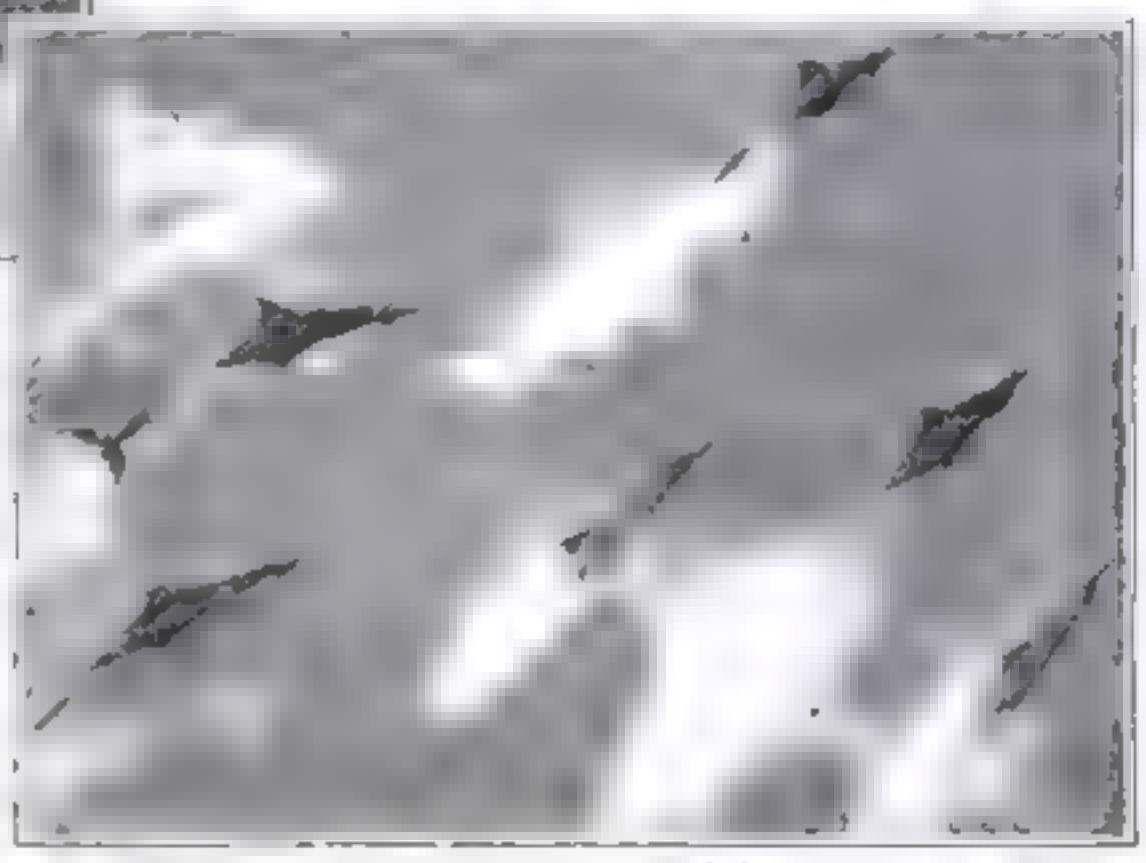
Transfers are printed while you wait by a new machine put into use on Berlin, Germany, street cars to speed up rush hour service. They also avoid fraud by the conductor, for the entire operation is performed before the passenger's eyes and he can see that a new transfer is issued to him instead of an old one pulled out of the conductor's pockets.

The transfer machine is carried slung around the neck of the conductor and is in a small metal case. A series of wheels on one side allows the machine to be set for the correct transfer. The conductor turns a crank on the other side which prints the transfer on a continuous roll of paper. As the crank is turned completely around, the transfer issues from the case and is torn off by the conductor and given to the passenger.

The machine is credited with being able to print and punch a transfer in less time than the conductor could tear one off and punch it under the old system. It also keeps a mechanically exact record of the number of transfers issued, thus reducing the possibility for theft by the employes and making it easy for the auditors to get quick report on total business.

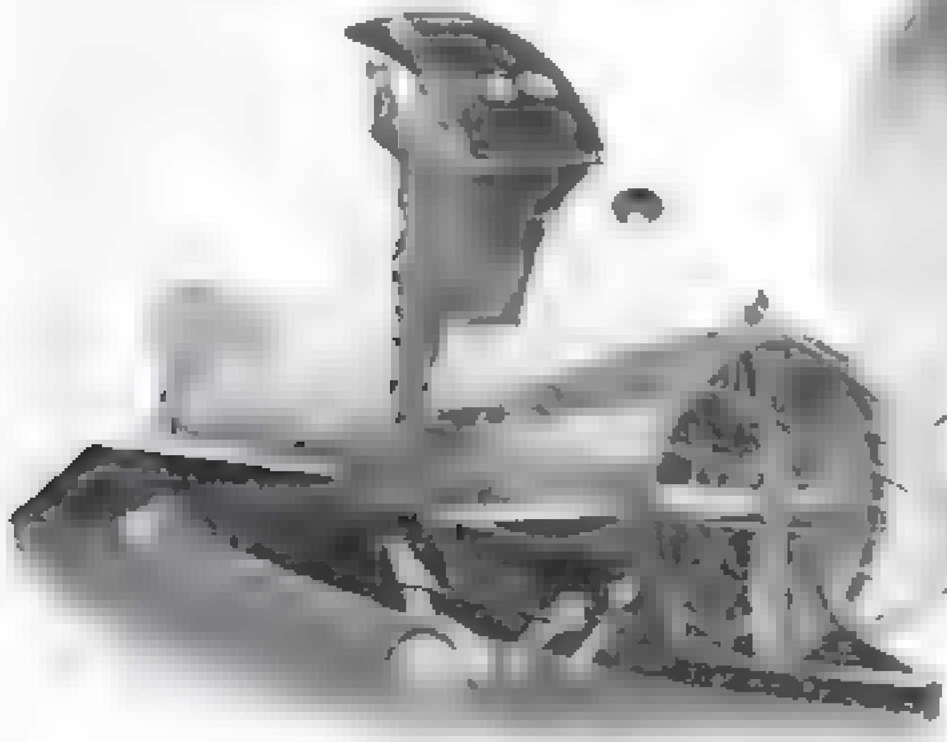


Odd Views of Animals Caught by Camera Reveal Unusual Traits

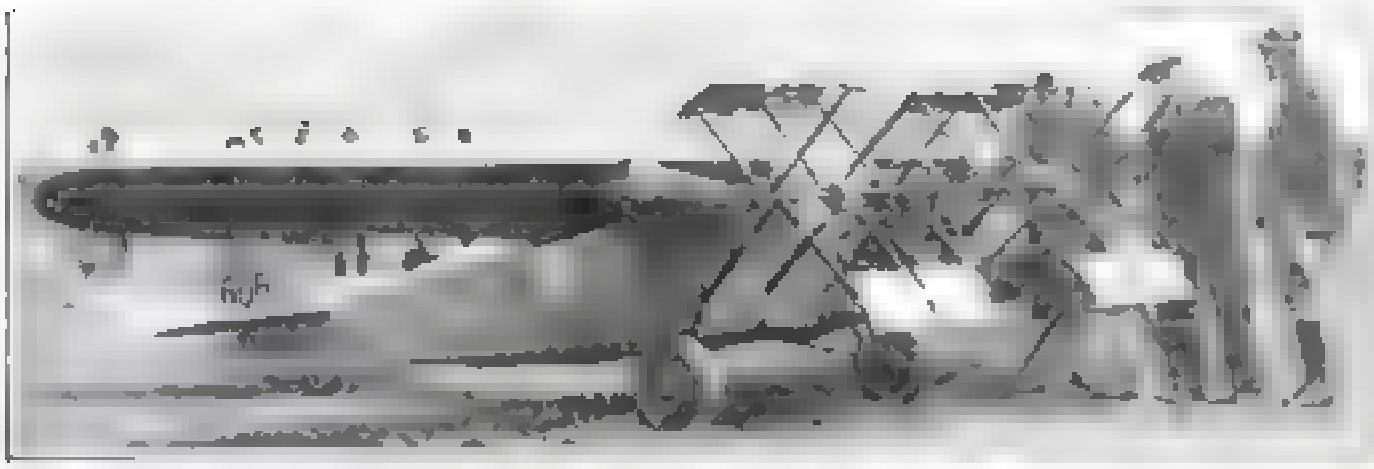


cock and domestic hen.

Odd Flying Machines Designed in Effort to Vary Usual Models of Planes

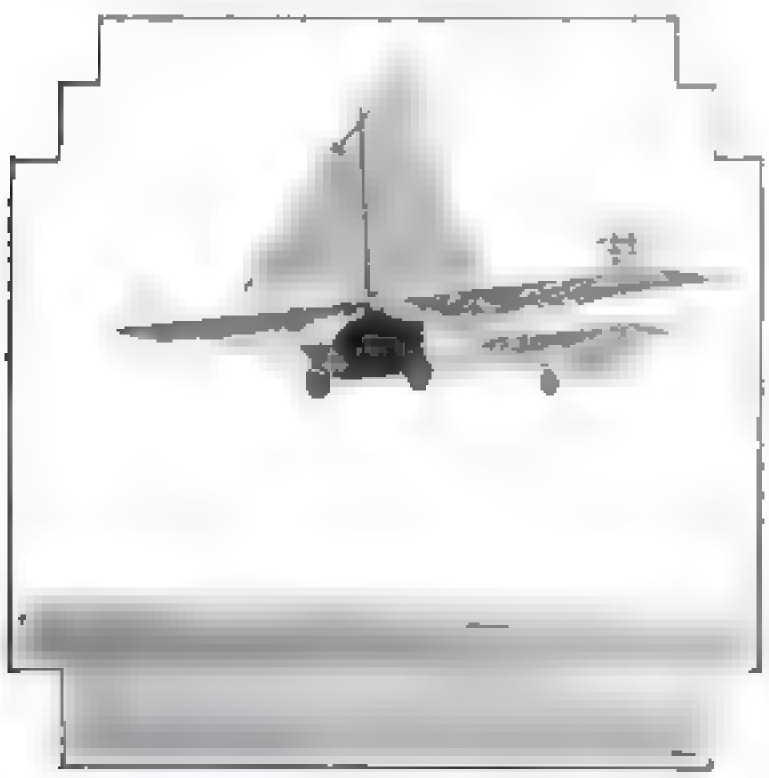


BOAT OR AIRPLANE? This strange craft, two views of which are shown, looks as though it would be more at home in the water than the air. Its inventor, a former member of the German air force, is sure it will fly. The air stream from the propeller is directed straight through the fuselage, which is hollow. The rear view, above, shows the rudder and the opening through which the air from the propeller escapes. At left, it is seen landing on Lake Florence near East Berlin, N. J. Its inventor claims the craft will fly 330 miles an hour and he is ready to try a flight in it from America to Berlin.

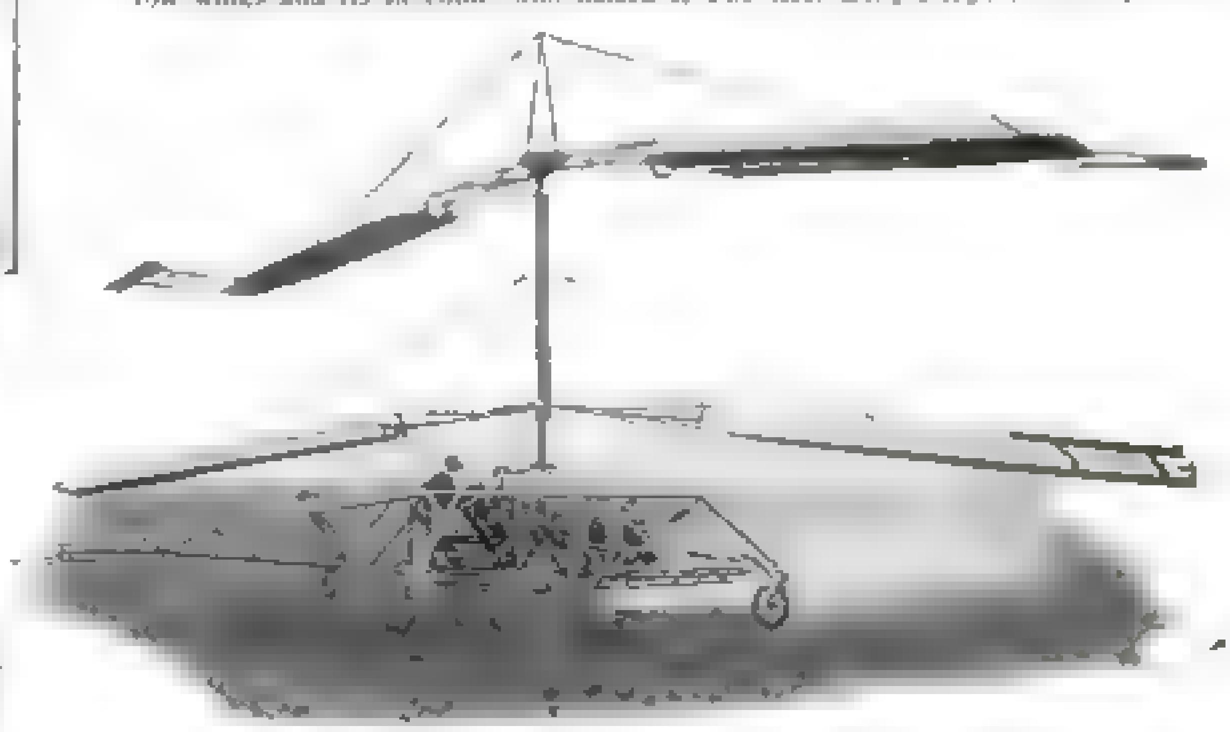


NO PROPELLER NEEDED. This plane, [illegible] designer, [illegible] accepted [illegible], has in place of a propeller paddle wheels similar to those used on old boats. They are expected [illegible] but no practical tests have been made.

"THE LAST LAUGH." Shaped like a beetle, this strange craft has long narrow wings and its inventor, who named it *The Last Laugh*, says it will fly



ALOFT UNDER FULL SAIL. Equipped with sails, this glider took to the air after being towed by an automobile. It flew, but aviation experts say it did so, not because of the sails it carried to help it, but in spite of their resistance.



DESIGNED FOR VERTICAL FLIGHT? The Italian-built helicopter at the right resembles in general the machine built at the [illegible] plant. This plane has risen straight into the air for short hops in experimental tests.

SHOCK-ABSORBING RAILS ADD TO TRAIN'S COMFORT

SHOCK-ABSORBING rails for railroads are the recent invention of a German engineer They are said to cushion the vibration of wheels rolling over them and to make traveling more comfortable for passengers in the coaches

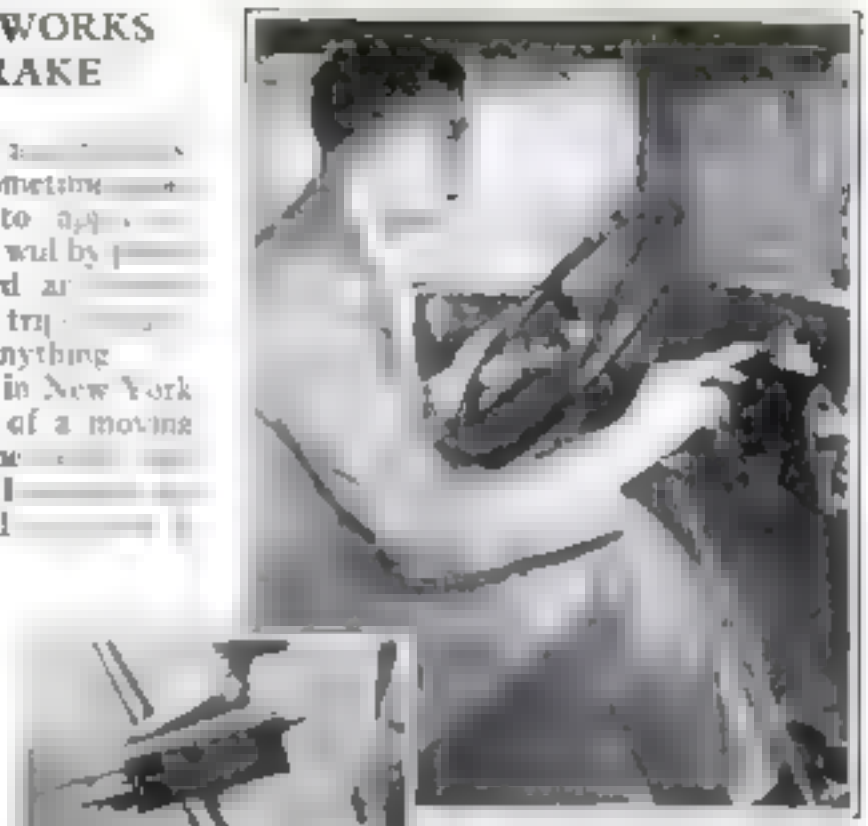
At intervals in a standard rail is inserted a section of special "breathing rail" of modified form and bearing a number of slots. These sections, welded to the regular rails against which they abut, give the whole track resiliency and absorb the jouncing of a train passing over it Tests of the device upon German railroads are planned.

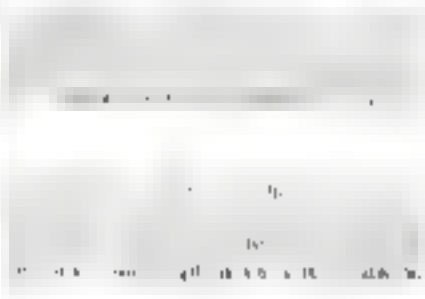
FRONT BUMPER WORKS NEW AUTO BRAKE

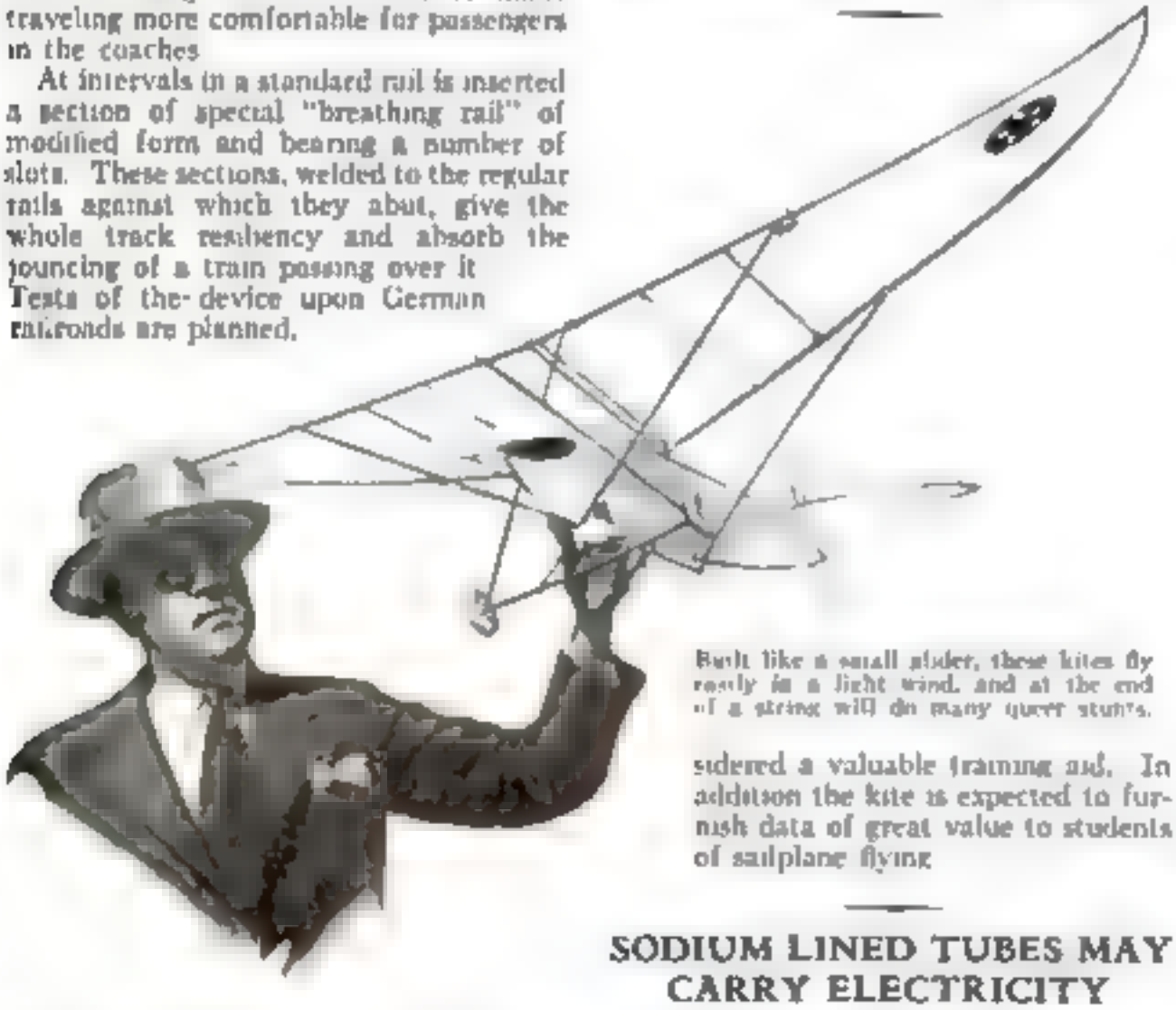
AN ELECTRIC brake for a[illegible] just placed on the market, sometime[illegible] not wait for the driver to appl[illegible] Although he can operate it at will by p[illegible] ing a button in the dashboard a[illegible] contact on the front bumper tri[illegible] matically if the car strikes anything

In a recent demonstration in New York City, a man stood in front of a moving automobile equipped with the [illegible] allowed himself to be hit [illegible] brakes of the car slammed [illegible] stopped in its tracks.

Any car may be equipped in a few hours with the brake, which takes its power from the car's own storage battery. The working part of the electric brake, housed in a small oblong box, is mounted on the chassis and acts upon an extension of the regular brake rod. When tripped, it first snaps off the ignition and then applies the four-wheel brakes, bringing the car to a quick stop.







Built like a small glider, these kites fly ready in a light wind, and at the end of a string will do many queer stunts.

GLIDER-KITES DO STUNTS WHILE HELD BY STRING

THE newest sport designed for glider enthusiasts is a glider-kite, to be flown by a cord from the ground. It is almost an exact model of an actual size glider and has a wing spread of about five feet

The glider-kite is capable of all varieties of stunting—loops, barrel rolls, and tail spins. It is believed that it will prove valuable in learning facts about the performance of a real glider, under various wind conditions and maneuvers. As a target in antiaircraft gun practice, it is also considered a valuable training aid. In addition the kite is expected to furnish data of great value to students of sailplane flying

SODIUM LINED TUBES MAY CARRY ELECTRICITY

WILL tubes or pipes, instead of wires, carry electricity to your home in the future? Such a possibility is proposed as the result of a recent survey of the prices of metals, which show that modern methods have made the curious metal sodium as cheap, bulk for bulk, as iron

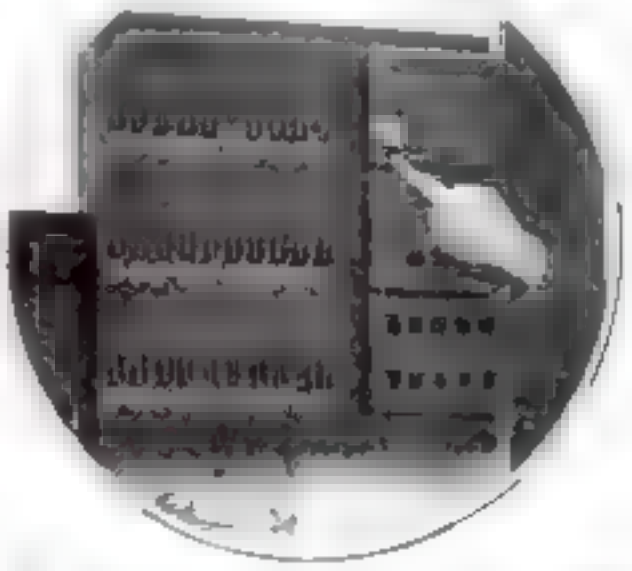
Pure sodium is a silvery metal, lighter than water, and so soft it may be cut with a knife. Thrown into water, it will explode

One of its most interesting properties is that a wire of sodium need be only one third the weight of copper wire to carry the same amount of electricity The metal is too soft to string by itself, from pole to pole, but it may be possible to use a thin-walled tube of copper or stainless steel, filled with a sodium core

AUTOMATIC WATCHMAN RINGS ALARM BELL

AN AUTOMATIC "night watchman," who keeps tabs on all the rooms of an apartment house by sounding an alarm and indicating the number of the room where an attempt at intrusion is being made, has recently been introduced by an Italian inventor

The novel burglar alarm is a signal board placed at some easily accessible point in the building. The locks of all the apartment room doors are connected by wire with this board. When one of the doors is forced or a wrong key inserted in the keyhole, a bell rings and the number of the room is registered on the board The janitor, other inmates, or passers-by on the street may thus be summoned to the scene.



The door to each apartment is connected with this switchboard. Bell rings if door is forced.

BABIES BRANDED WITH ULTRA-VIOLET LIGHT

Ultra-violet rays are used to "brand" new-born babies at the Delaware County Hospital near Philadelphia, to prevent the possibility of giving a mother the wrong child. The marking, entirely painless and harmless, will make impossible the repetition of "exchanged babies" such as took place recently at a Chicago hospital

In placing the "coat-of-tan" markings upon the new-born infant, the ultra-violet rays are directed upon a stencil in which numbers or letters are cut so that the "sunlight" reaches only the exposed skin. The markings remain visible for two weeks or longer, until the child is taken from the hospital, and, of course, bathing does not disturb the markings as would be the case if put on by usual means.

With this ultra-violet machine, hospital babies are branded with a number or initial by means of which they are identified.

PRESSING TRIGGER FIRES OIL FROM THIS CAN

A new oil can that works like a gun shoots lubricant into hard-to-get-at places. Built like a miniature force pump, it is operated by pressure on a trigger. In response to the touch, a jet of oil spurts through the long spout and easily reaches the machine part to be lubricated. There is no need to turn the can upside down and attempt to splash on oil from above with this positive feed.

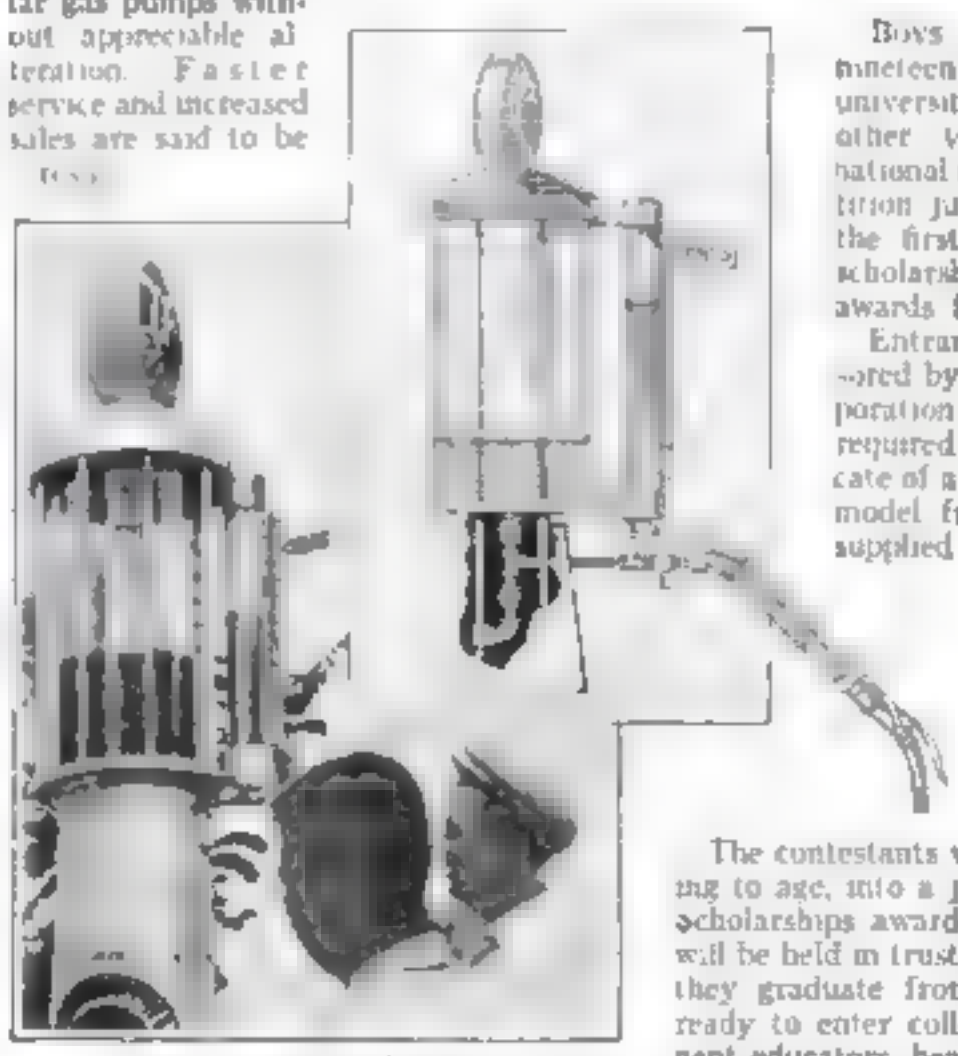
Within the can, a plunger connected to the trigger advances into a cylinder in which a measured quantity of oil is trapped and when the trigger is pulled it ejects this oil The forcible action makes the spout proof against clogging This insures the lubrication of the invisible parts of the motor

Bearings hard to get at are easily lubricated with this gun device which shoots the oil out

MOTORISTS CAN NOW GET THEIR CHANGE IN GAS

When a driver stops at a new kind of filling pump to buy gasoline for his car, he may receive his change, if he prefers, in gasoline. Beside the regular glass tank is a smaller one containing exactly one gallon of gas. It is graduated in cents Any number of cents' worth of fuel may be drawn from the small tank, when the attendant presses a lever at the nozzle of the regular filling hose

If a driver buys five gallons of gasoline, for example, at nineteen cents a gallon, his bill would be ninety-five cents. Giving the attendant a dollar, the motorist need not wait for his change. He receives it immediately in five cents' worth of gasoline drawn from the small tank. Filling stations may add the device to their regular gas pumps without appreciable alteration. Faster service and increased sales are said to be [illegible]



A one-gallon tank, graduated in cents, is used to give purchaser his exact change in gasoline.

SLOWS MOTORBOAT DOWN TO RIGHT FISHING SPEED

An outboard motorboat is slowed to rowing speed by a new propeller attachment for fishermen who wish to troll. The device covers the propeller blades and thus takes away their normal pitch. With the motor throttled down, the usual speed of the boat is reduced by half with the trolling attachment

All standard makes of outboard motors may be fitted with this invention of a Little Falls, Minn., manufacturer, and it is made for both two- and three-bladed propellers. It can be attached or detached on the water, and is made of cast aluminum so that it will not rust.

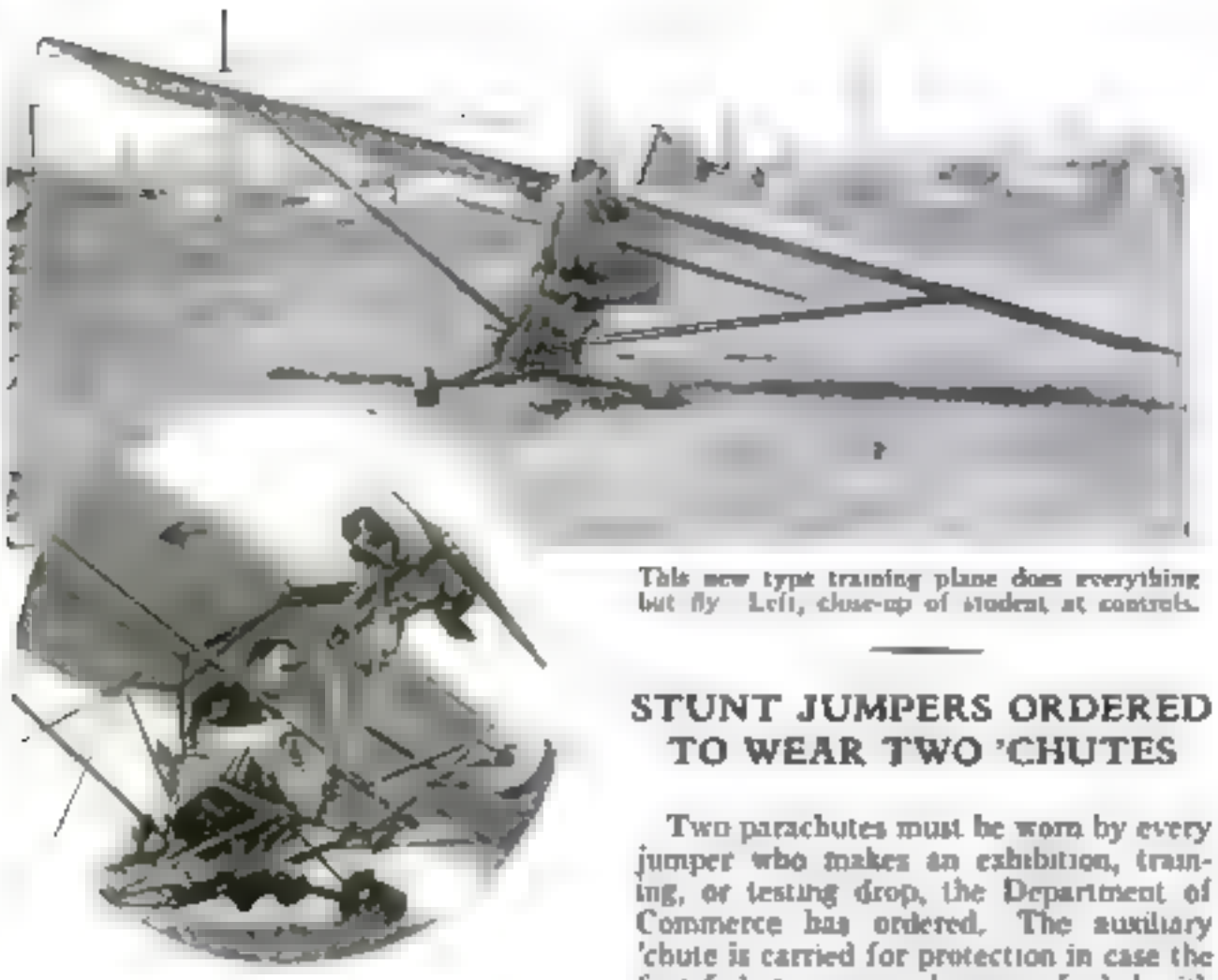
When the motor is speeded up, wings on the device automatically spread and expose the propeller blades. Nearly normal speed may therefore be reached without removing the attachment.

OFFER $50,000 IN PRIZES FOR MODEL MAKERS

Boys between twelve and nineteen years of age may win university scholarships, and other valuable prizes, in a national coach-modeling competition just announced. This is the first time that university scholarships have been given as awards for craftsmanship.

Entrants in the contest, sponsored by the Fisher Body Corporation of Detroit, Mich., are required to construct a duplicate of a Napoleonic stagecoach model from working drawings supplied them. For the most nearly perfect specimens of handwork, prizes totaling $50,000 in value will be awarded, including four four-year university scholarships.

The contestants will be divided, according to age, into a junior and senior class. Scholarships awarded in the junior class will be held in trust for their winners until they graduate from high school, or are ready to enter college A jury of prominent educators, headed by Dan C. Beard, will judge the models.



This new type training plane does everything but fly. Left, close-up of student at controls.

STUDENTS LEARN TO FLY IN CLIPPED WING PLANE

Now students can learn to fly on the ground yet get all the sensations of actual soaring, in a plane that has had its wings "clipped." It will tip, bank, and behave in every way like a real airplane, but it cannot leave the ground

The earthbound craft, devised by two Los Angeles inventors, is a small glider powered with a two-cylinder motor. Its wing surfaces are responsive enough for the machine to answer its controls while jogging along at only ten or fifteen miles an hour When the student has mastered it, he replaces the stub wings with full-sized ones and flies away.

PARACHUTE FOR PLANE WORKED BY SPRINGS

Springs fire into the air the plane-lowering parachute invented by Dr J. T Parr, an Oakland Calif., dentist. When the pilot of a disabled plane presses a control lever, a trapdoor in the upper wing opens and the parachute swings plane and pilot to earth. Such "airplane parachutes" have already been shown feasible in tests, and Parr declares the release of his device so positive that it will check a plane in headlong fall, out of control. The parachute is attached to the plane at the exact center of balance, so that when put into use it will, according to the inventor, hold the plane on a level keel during the descent so that it will not be damaged when the ground is reached.

STUNT JUMPERS ORDERED TO WEAR TWO 'CHUTES

Two parachutes must be worn by every jumper who makes an exhibition, training, or testing drop, the Department of Commerce has ordered. The auxiliary 'chute is carried for protection in case the first fails to open or becomes fouled with some part of the airplane. Pilots wear only one parachute as they jump only in emergencies and the added bulk of a second would interfere with their work.

Above is view of parachute, released by springs, lowering plane to earth. Below, how chute is packed at center of wings.

RADIO BEACON GUIDES PILOT'S BLIND FLIGHT

Fog might have blanketed his whole trip, yet it would not have stopped Capt. Arthur Page, crack Marine Corps pilot, who recently flew "blind" from Omaha, Neb., to Washington, D. C. Stopping only twice on the way, at Chicago and Cleveland to refuel his plane, Captain Page guided his plane solely by the instruments on the dashboard in front of him.

The illustration shows the visual radio beacon indicator that kept him on his course without the necessity of watching the ground. To avoid risk, he carried an observer who did watch the earth, but the observer found it unnecessary to give Page any directions and contented himself with keeping a lookout for other planes.

The visual radio beacon guided Captain Page above from Omaha to Washington, D. C.

2,000 COMPANIES BUSY MAKING MODEL PLANES

Nearly 2,000 full-sized airplanes, motors and all, could be purchased with the money now invested in the model airplane industry of America. Last year more than 2,000 companies, ranging from "basement factories" run by schoolboys to producers with large financial resources were turning out the light, rubber-band-propelled machines. One firm sold $400,000 worth of miniature planes in twelve months. The model airplane industry in the United States now represents an investment of approximately $4,000,000.

WORLD'S BIGGEST AIRSHIP TO BE NAMED *AKRON*

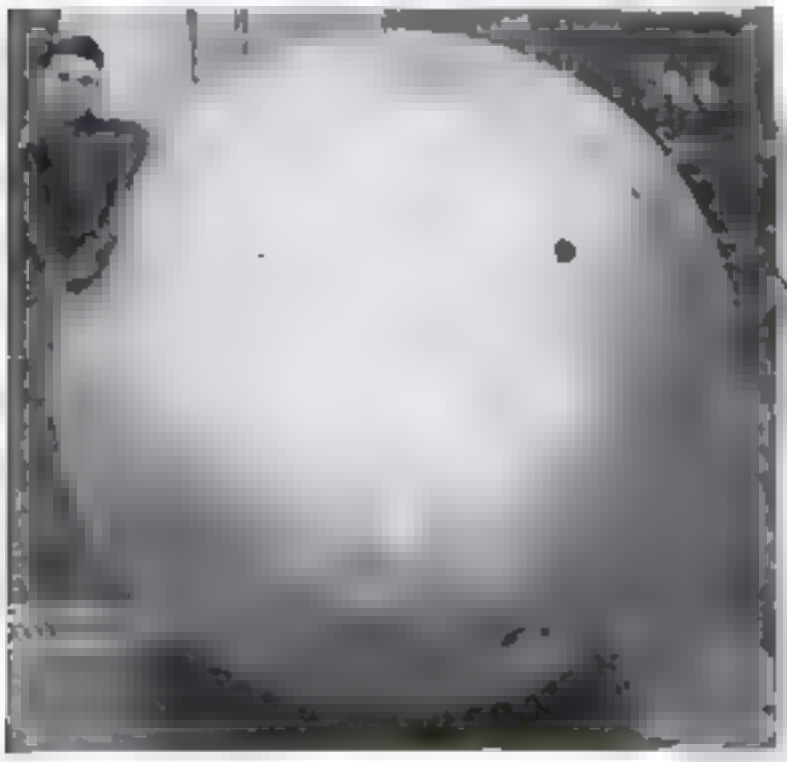
When the world's largest dirigible emerges next summer from the hangar at Akron, Ohio, where it is being constructed with a sister-ship of equal size for the United States Navy, it will carry the name *Akron*

This recently was selected as the name of the new super sky dreadnaught by Navy officials Heretofore the airship was designated as the *ZRS-4*, and its sister-ship, still unnamed, the *ZRS-5*. These giants will have a gas capacity greater by a million and a half cubic feet than the largest airships now in existence. Each will hold 6,500,000 cubic feet of helium. The only Zeppelin type dirigible now owned by the United States is the Navy's six-year-old *Los Angeles*, originally the *ZR3*.

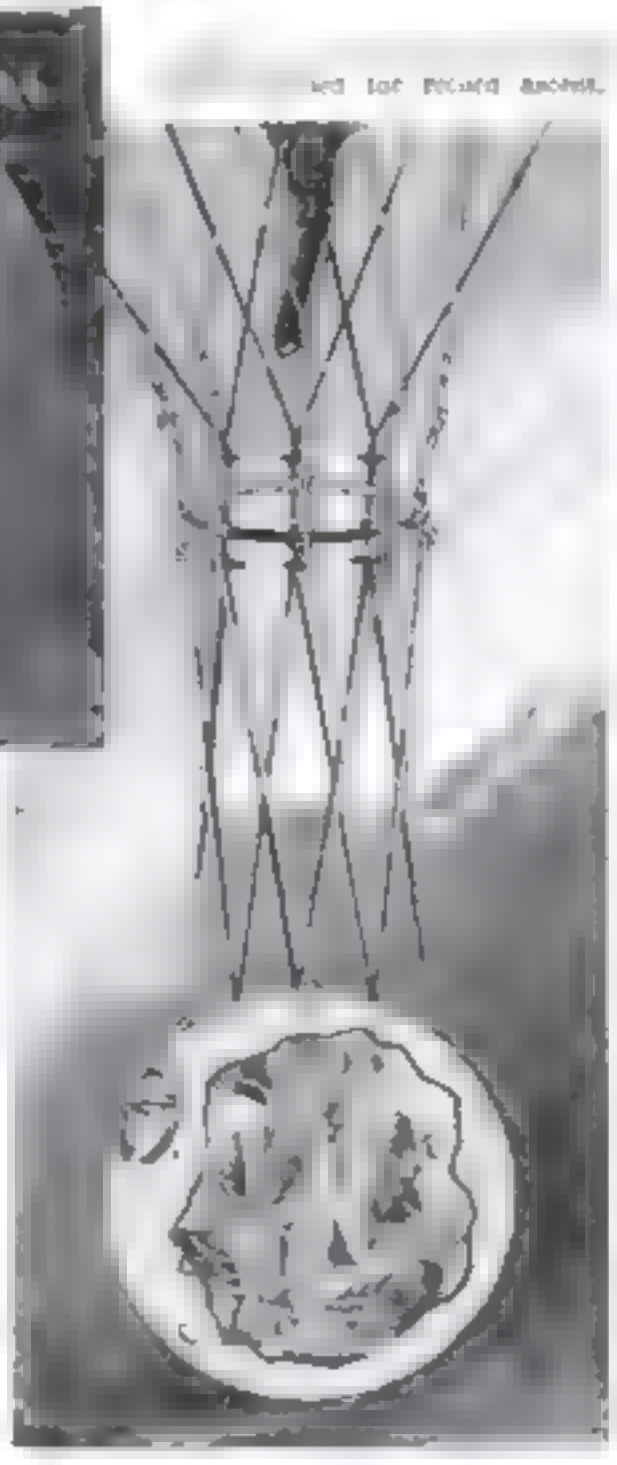
PLANE'S NEW MAIL BAG UNHARMED BY FIRE

ONE of the great menaces to the safety of air mail is fire. To protect air cargoes—sometimes valued at more than a million dollars—a new fireproof asbestos composition mail bag was tested at Chicago. It was soaked with gasoline and left for fifteen minutes, the bag being the mail within unharmed. The new mail holder is said to be capable of withstanding heat that would melt steel.

PLANS TEN-MILE CLIMB IN BIG BALL



In this seven-foot aluminum ball [illegible] will be carried ten miles above [illegible]



[illegible] test for record ascent.

[illegible] normal atmospheric pressure within the ball, despite the low [illegible]

STUDIES AIR THRILLERS WITH MODEL AT HOME

WHEN Lieut. Alford J. Williams, former Navy flyer, plans an air thriller such as his recent spectacular "inverted falling leaf," he uses a model plane to do it. Sitting comfortably in an armchair at his Washington, D. C., home, he can study out at leisure just when he will have to advance the control stick or kick over the rudder.

Even an experienced airman might become bewildered at some point in the midst of the hair-raising stunts that Williams has performed. For instance, when a plane is standing on its side the rudder and the elevator, controlling respectively the horizontal direction and tilt of the plane in normal flight, exchange duties. At such a time hesitation might be fatal. That is why Williams, reckless as he seems in the air, has rehearsed his stunt with a model so many times that his responses when in a tight place are automatic.

FLYING BOATS USED TO CATCH FISH POACHERS

POACHING fishermen within the three-mile limit along the British coast on the North Sea are being caught with flying boats. Machines of the Royal Flying Corps patrol the sole fisheries in these waters. When French and Belgian fishing vessels were sighted by the waged game wardens, they radioed to the ships of the Fisheries Protection Flotilla. Arrests followed. With the success of the aerial patrol it is planned to extend the use of the flying boats to the herring fisheries at other points along the coast.

REVOLVING SEATS ADD TO RAILROAD COMFORT

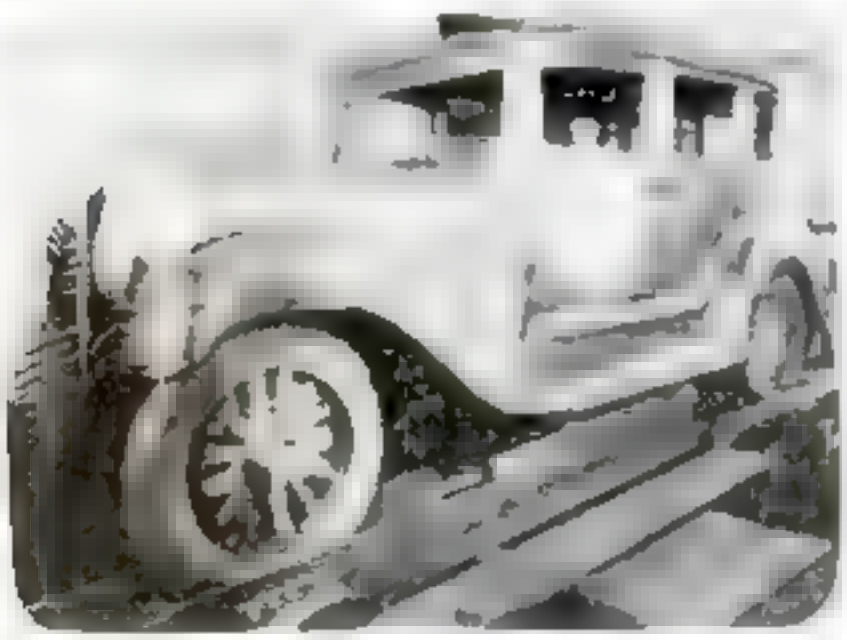
THESE double seats for railroad cars, mounted on a pivot, turn toward the window like Pullman chairs at the will of the occupants. The innovation in railway seating was recently tried out successfully on a Chicago-to-Denver railroad line, and other roads are considering its adoption

Tilting backs add to the comfort of the heavily-upholstered chairs, which may be adjusted to any angle by levers at the of them. A rack at the back holds coats and hats out of travelers' way

"BELGIAN ROLL" TO SHAKE CAR APART

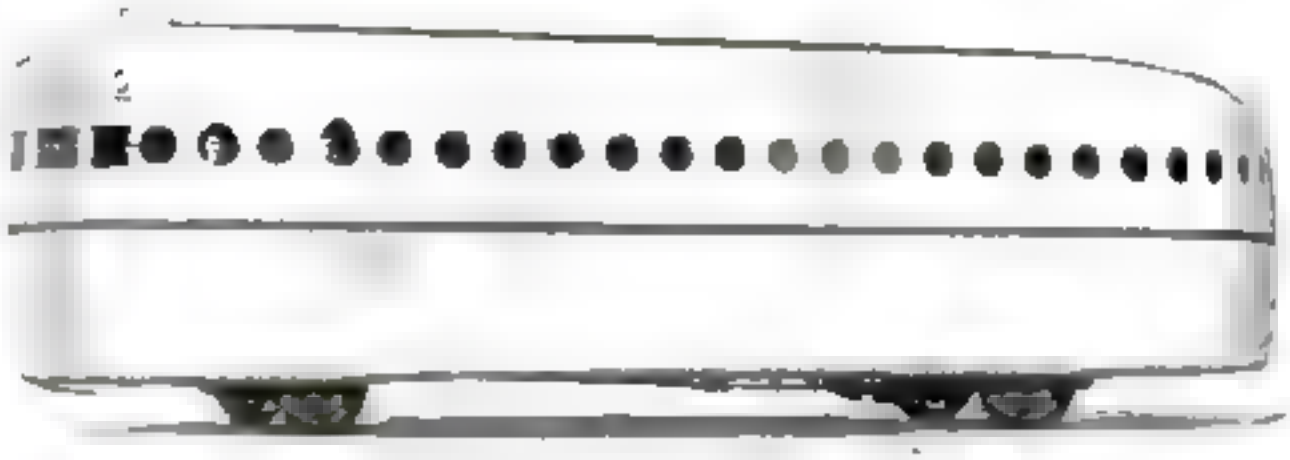
AN AUTOMOBILE is turned into a bucking broncho by a mechanical device called the "Belgian Roll," which is used in a Detroit automobile plant to test cars. The function of the "Belgian Roll" is to shake and shock a car to pieces. If the test car discloses weak spots, they are made stronger in future models

The "Belgian Roll," built in a pit, consists chiefly of four large eccentric rollers. When a car is lashed in position over the test pit with its wheels on these rollers, their wobbling revolutions throw the car up and down in a series of rapid jolts.



The "Belgian roll" in operation. The picture was taken while the auto was being violently agitated by the erratic rollers. This test is made to discover any weak spots in the car.

85-MILE-AN-HOUR BUS STREAMLINED



France is soon to see this streamlined, high powered bus with porthole windows, whizzing across the country on overland routes carrying 100 passengers and running at more than express train speed.

PORTHOLE-shaped windows will give passengers a view of the roadside they are scudding past at eighty-five miles an hour, in a remarkable bus just completed at Paris, France. This juggernaut of the roads seats 100 passengers, besides its two drivers. Every part is streamlined for speed, even to the curved emergency door in the rear. The machine is designed for express cross-country travel

NEW LENS CLEANING KIT MADE FOR CAMERA MEN

CLEANING a photographic lens, without doing it more harm than good, is not as simple a matter as it sounds. Experiments made at Hollywood, Calif., where there are many lenses to clean, showed that most of such cleaning was worse than useless, and in many cases it was said to actually impair the quality of photography and projection

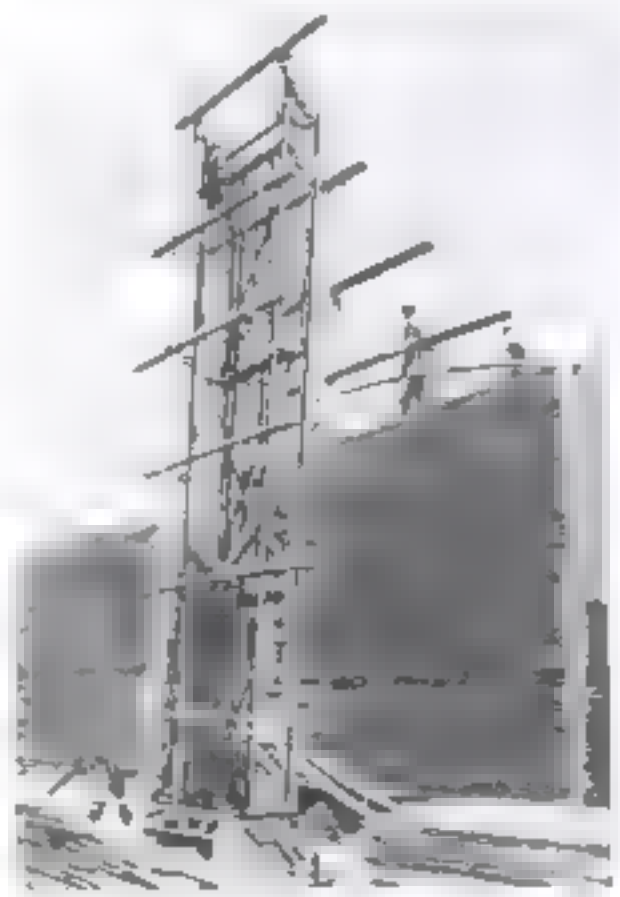
To meet this situation a new lens cleaning kit has just been developed. It consists of a fluid, the nature of which is a trade secret, a piece of specially tanned and hand-brushed chamois, and a bit of lintless linen made from Irish flax. A camel's-hair brush to remove dust completes the outfit. It is designed for use with all kinds of lenses, including those of a microscope.

LUMBER PILING MACHINE AIDS RUSSIAN INDUSTRY

PILING boards twice as high and many times faster than men could do it, a new machine for stacking lumber is the latest labor-saving device put into use in Soviet Russia. The machine is operated by an electric motor and stands about thirty feet high.

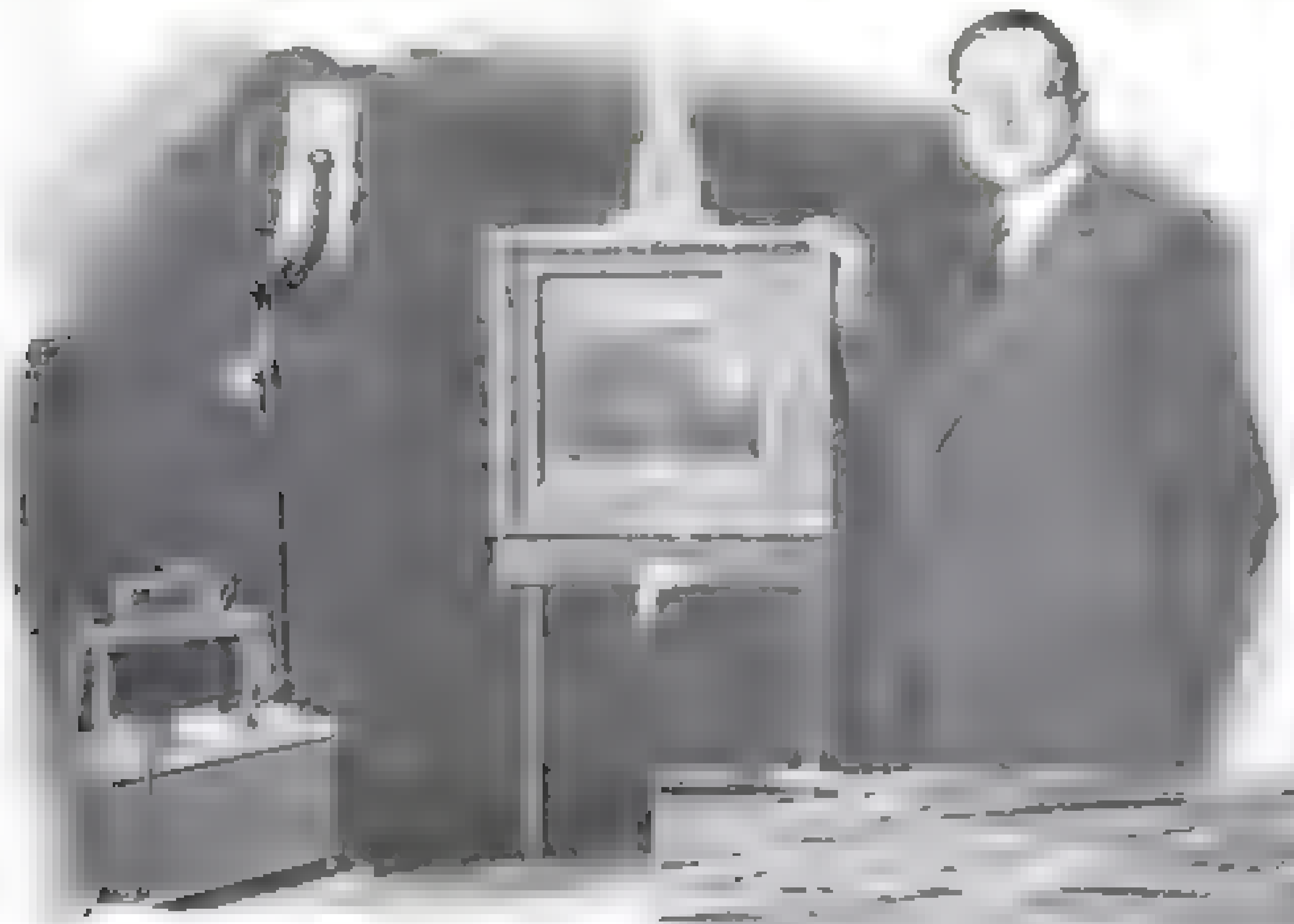
Lumber is laid on steel bracket extensions attached to an endless chain. The planks are carried to the top of the machine where levers shift them from one side of the bracket extensions to the other so that they are always on top. The planks are then carried down the other side of the machine until they reach two long steel arms down which they slide. A laborer on the stack of lumber then picks them off and places them on the pile, as illustrated in the photograph below

With the use of this machine, two or three men are able to do the work for which, under the old method, a large crew was needed. As the lumber industry of Russia is in the process of rapid development, a machine of this kind was indispensable. It was designed by native inventors at the request of the government.



Soviet Russia has just installed this lumber piler which does the work of many men.

LAMPS RID PRICELESS STATUE OF PESTS



[illegible] Fernand Ce[illegible]erier, who saved the rare [illegible] At right [illegible] section of wood [illegible] was made from [illegible]

[illegible] priceless sculpture saved [illegible] by powerful lamps

A PRICELESS 400-year-old piece of wooden sculpture in the Louvre [illegible] was recently saved from destruction. How the scientific use of lamps conquered the insects that were destroying it has just been revealed by Fernand Cellerier, official "doctor" of the statues and paintings in the French institution.

An Alsace museum presented to the Louvre the statue, seven feet tall, of the Virgin carrying the infant Jesus. It was highly valued as a choice example of fifteenth-century German sculpture.

Two years ago, a vast cloud of insects swarmed from the statue. Consternation seized the museum officials and the priceless relic was immediately examined. It proved to be the nesting place of quantities of insect grubs whose growth had been hastened by the gallery's warmth. Antiseptics were injected to kill them and the statue was replaced.

In April of last year, another swarm of insects appeared. Cellerier, the statue expert, was called in and set up a laboratory in the Louvre.

Taking small slices of wood from the back of the statue he examined them under the microscope and found them to have come from the trunk of a linden tree. It was then easy to identify the insect as a beetle-like species of the family known as Anobies.

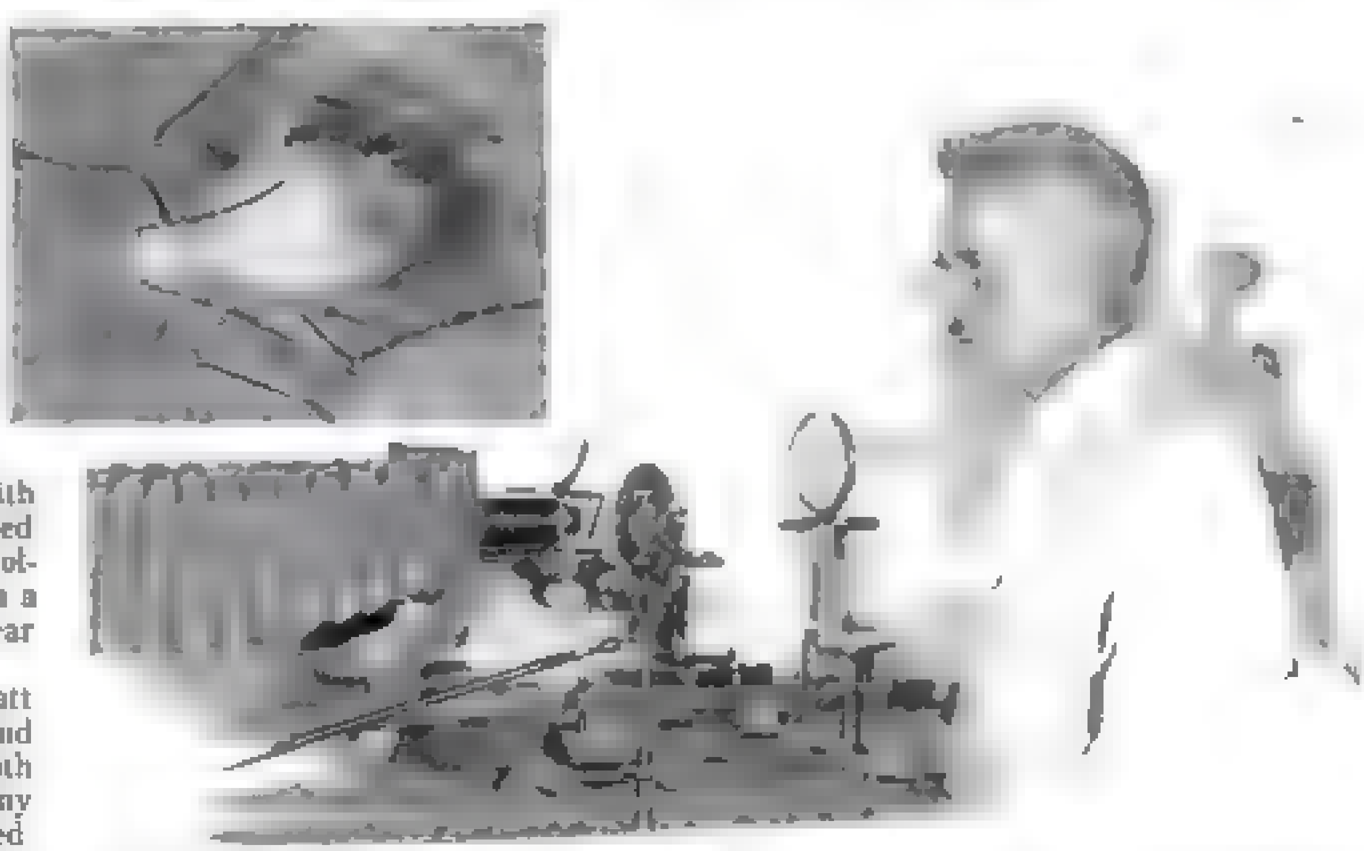
The last step was the use of one of Cellerier's own inventions, a hermetically sealed cabinet in which the statue was exposed to the rays of powerful lamps for thirty days. This type of treatment is used widely to preserve rare woods. Applied to the statue, it baked it dry of sap, which had served as food for the larvae. When the statue was removed from the case, it was free of the pest.

NEW PROCESS SHOWS MITES AS GIANTS

MITES become monsters before the camera of J. G. Pratt, United States Department of Agriculture photographer. After years of research, he has discovered a process by which he can take pictures of insects and plants magnified to astonishing size—from twenty to three hundred diameters.

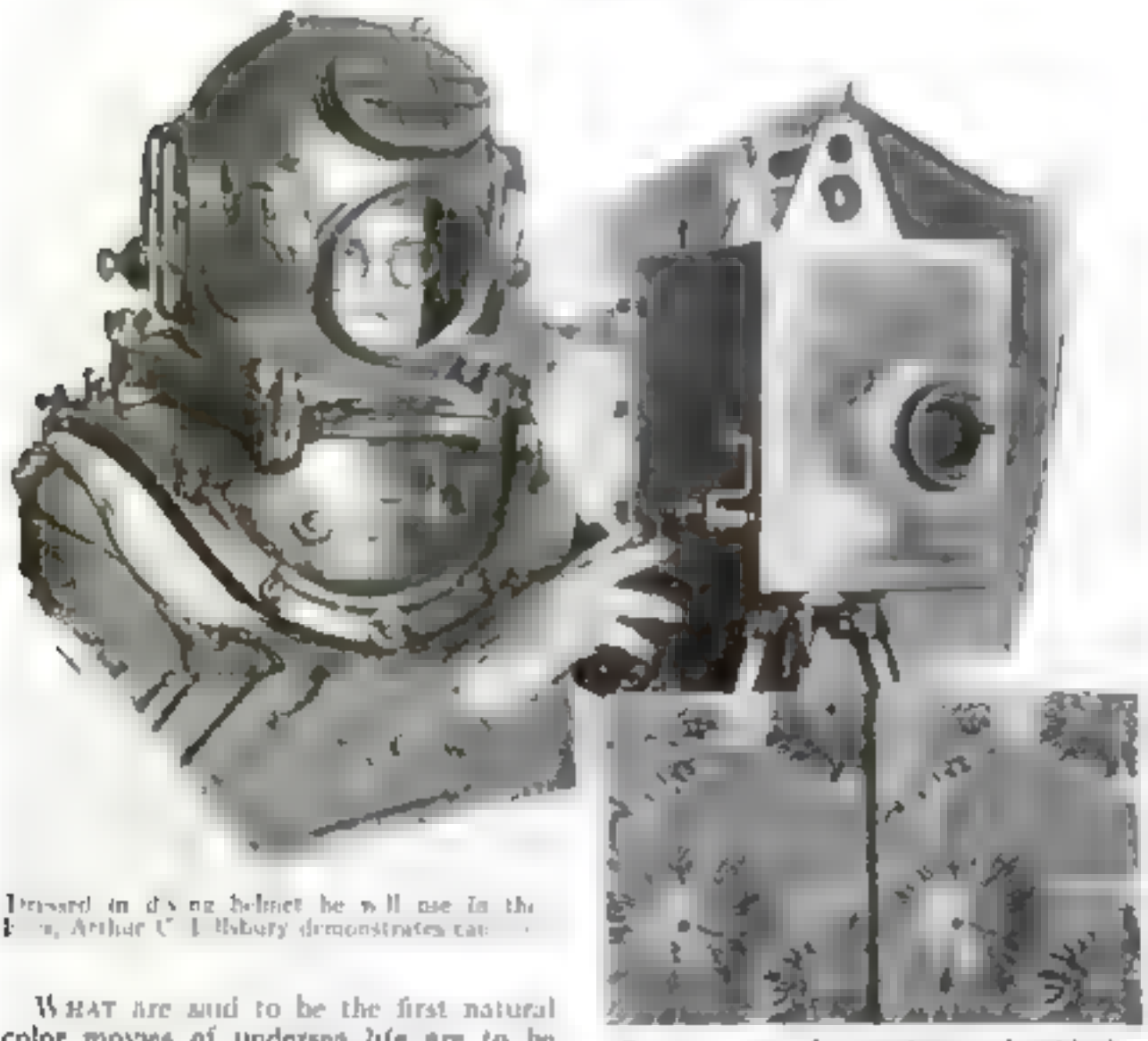
Pratt's achievement is considered remarkable because he can picture with clarity of detail a whole insect, magnified to giant size. Formerly a textbook of biology could show only a drawing of such a subject, necessarily failing to give a clear idea of its appearance.

Armed with his special camera, Pratt has pictured such insects as the plant aphid or "ant cow" which supplies ants with honey food. According to Pratt, the tiny insect has never before been photographed. Other pictures which he has made show how a fern propagates itself by spores.



J. G. Pratt, Government photographer, shows how he makes highly enlarged pictures of insects. Inset is a photo of tiny aphid taken by Pratt and magnified about twenty-five diameters.

TO MAKE COLORED MOVIE OF FISH



Dressed in diving helmet he will use in the [illegible], Arthur C. Pillsbury demonstrates camera

Two exposures of sea-urchins made with the camera to be used under water in filming fish

WHAT are said to be the first natural color movies of undersea life are to be filmed by Arthur C. Pillsbury, Berkeley, Calif., photographer. He and Mrs. Pillsbury recently sailed for the tropical island of Suva, in the midst of the Fiji Islands, where he plans to photograph giant starfish, sea anemones, and rare tropical fish at depths from fifteen to fifty feet beneath the surface. There, clad in bathing suits and diving helmets, Pillsbury and his wife will work in shifts of one hour.

The special cameras which they took with them have been proved water-tight by immersion in San Francisco Bay for twenty-four hours. Each is inclosed in a sealed housing of brass, with a window of fine optical glass. Attachments on the box permit Pillsbury to change films under water. Pillsbury plans to expose 25,000 feet of film, if man-eating sharks and barracudas do not interrupt his work.

No effort will be made to get pictures of marine life at great depth as Pillsbury is not equipped with a diving bell. His interest primarily is in the more highly colored fish that live near the surface of the tropical seas. His photographs, supplemented with the data he will gather, should add largely to the scientific knowledge of these fish.

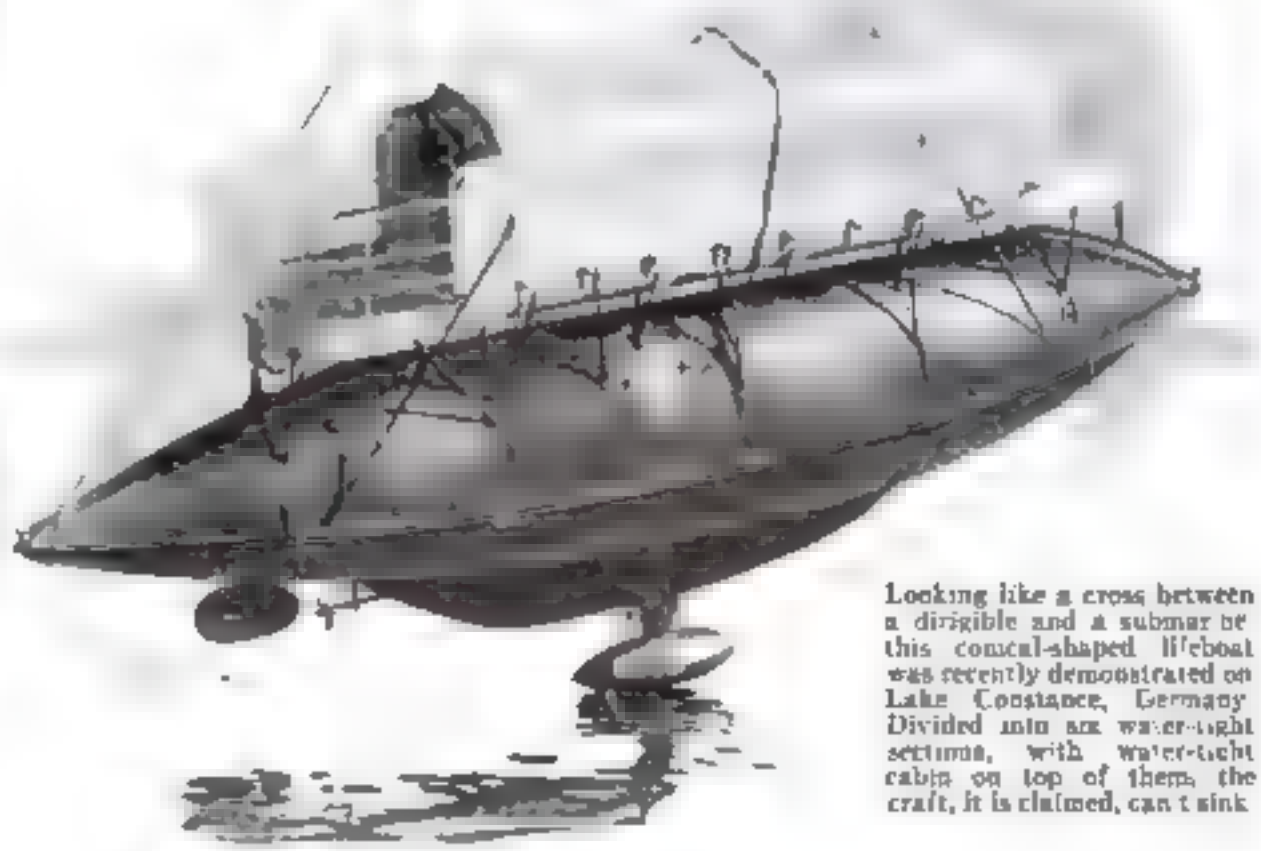
CALORIE COUNTER TELLS YOU WHAT TO EAT

DETERMINING the number of calories, or units of heat energy, a person should have in his daily diet, a "calorimat" is being installed in public places of Berlin, Germany. The machine tests one's weight and height and then delivers a printed card from a slot giving the calorie ration for the day. Various foods contain different amounts of calories per pound, and by consulting a diet table showing these a person can adjust his eating habits accordingly so that he will be sure to get the required amount of nourishment.

Inserting a coin starts the machine. A system of levers and plungers operated by the person standing on the machine sets it in motion and out comes the card telling how much you should eat today. To assist people in determining what and how much to eat, some restaurants in the United States print on their menus the number of calories each dish contains.

UNSINKABLE BOAT MEETS TEST IN GERMANY

MORE like a submarine than a surface craft, this novelty in lifeboats is said to be unsinkable. Its seaworthy qualities were demonstrated not long ago in a trial trip over Lake Constance, Germany. The conical hull is divided into six water-tight compartments and a weight below helps maintain stability.



Looking like a cross between a dirigible and a submarine this conical-shaped lifeboat was recently demonstrated on Lake Constance, Germany. Divided into six water-tight sections, with water-tight cabin on top of them, the craft, it is claimed, can't sink.

WORK WITH BIG ROCKETS IS AGAIN UNDER WAY

NEW aid for his experiments with high-altitude rockets enables Prof. Robert H. Goddard, of Clark University, to continue the work he began several years ago. Daniel Guggenheim, backer of a recent safety contest for airplane types and of other important aviation researches, is helping Goddard. The rocket will be used for observations at high altitudes.

LIQUID PAPER, SHOT OVER LAND, HELPS FARMERS

Strips of soft paper to cover farm land have been tried in this country, where they protect growing shoots and increase the yield of corn and other agricultural products. The labor of laying these strips properly is lessened by the invention of a German engineer which sprays a fluid solution from a device like an air gun. When this strikes the ground, it hardens into paper, of a sort that is not dissolved by rain and impassible for the wind to blow away.

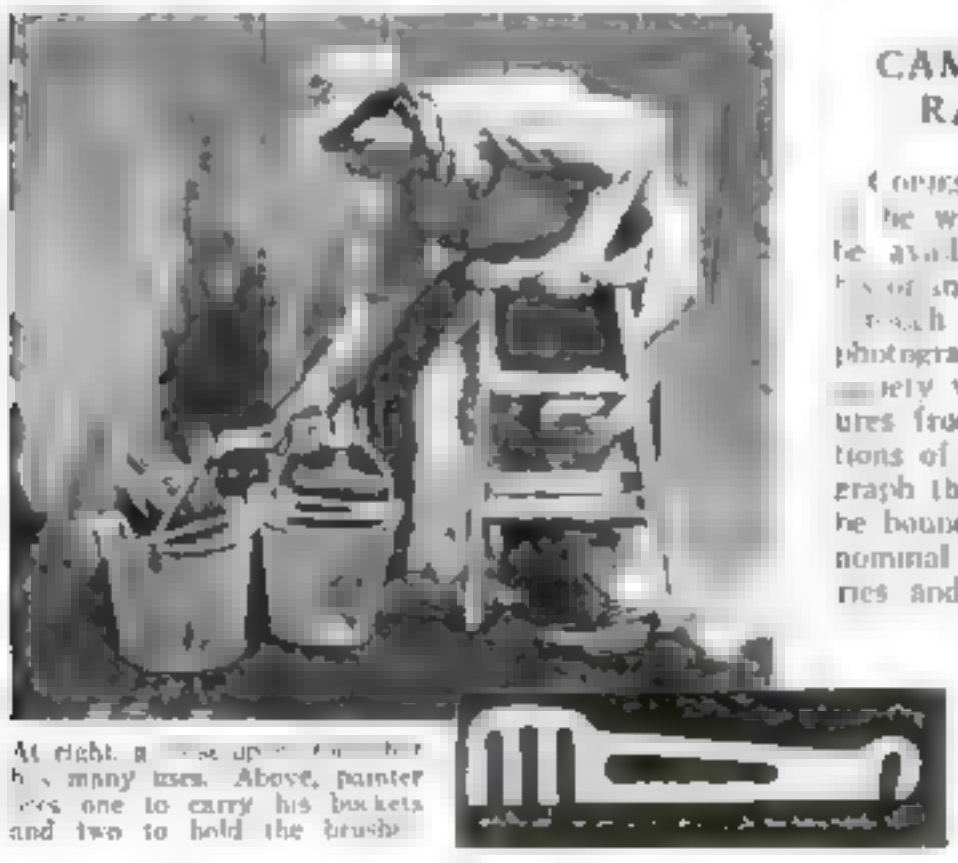
According to the inventor, Arthur Streich, who recently demonstrated the device in Berlin, it benefits growing farm plants by raising the soil temperature, killing undesirable insects, and protecting the beneficial bacteria in the soil

TOOL IS HANDLE, WRENCH, HAMMER ALL IN ONE

A piece of cold-rolled steel about a foot long and deeply notched is a new tool for the man who works around the house, as well as for professional house painters and decorators. It is scientifically designed for the greatest possible number of uses.

The five-ounce tool makes a convenient handle for carrying two buckets of paste or of kalsomine. Laid across the top of the bucket, the tool may be used as a rest for the brush. Slots engage the sides of the bucket, and the brush is held either horizontally or vertically. Its straight edge is more convenient than the curved edge of a bucket for wiping surplus paint from a brush. Two buckets can be carried and still have one hand free.

In addition, the tool serves as a hammer or as a stirring paddle, while a slot in its center enables it to be used as a wrench



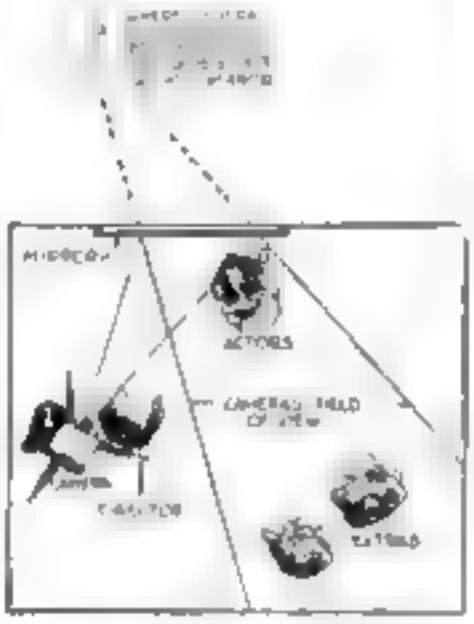
At right, a [illegible] has many uses. Above, painter uses one to carry his buckets and two to hold the brush

CAMERA COPIES RARE BOOKS

Copies of books so rare as to be without price will soon be available to students and libraries the world over, through the modern use of photography. A New York society will select book treasures from the greatest collections of the world and photograph their leaves. These will be bound and distributed at a nominal fee to sixty-four libraries and to the members of the society. Five rare volumes have already been copied in this way, and a dozen more are immediately to follow them

MIRROR GIVES DISTANCE TO MOVIE

A mirror is the secret of a new movie trick which makes a small room appear like a big one, thus saving studio space. The mirror supplies part of the distance. The picture and diagram show how it is done. Pointed at the mirror, the camera records the reflected images of the actors in the "set," thus adding appreciably to the depth of the scene as seen on the screen. The diagram below illustrates the process.



The suggestion of distance in the background is obtained by photographing the actors in the mirror instead of turning camera directly on them. Left: How it is done.

NEW HACK SAW BLADE HAS BIG AND LITTLE TEETH

Teeth, graduated from fine to coarse on this German hack saw, adds to tool's efficiency.

Fine teeth for starting a cut, and larger teeth for regular sawing, are combined in a new kind of hack saw blade. From one end to the other the teeth gradually increase in size. Only one half of the blade is used at a time. Made for cutting iron and steel, the blade is said to be unlikely to jam and break. The new blade is a recent German invention.

HIGHEST THING ON SEA IS *MAJESTIC'S* MAST

The highest thing on the sea is the mast top of the transatlantic liner *Majestic*. Operated at its slightest possible draft, its topmast towers 229 feet above the water line. This was disclosed by a survey recently made by Army engineers for the Port of New York Authority, in order to pass on a proposal to erect a railroad bridge over the Hudson River at a point where transatlantic vessels would have to steam under it. The survey showed that a fixed bridge 172 feet above high water at midstream, which had been proposed at first, would make it impossible for nineteen transatlantic passenger liners to pass underneath.

PINCHOT GETS FINE VIEW OF SKATE

At right an 800-pound [illegible] being hauled aboard Pinchot's boat. At left a picture of a big skate swimming

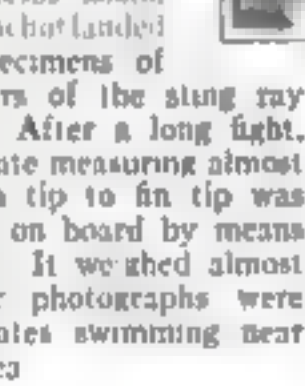
UNUSUAL photographs of skates were obtained by Gifford Pinchot, former governor of Pennsylvania, on his recent expedition through the Marquesas and French Oceanica in the southern Pacific Ocean.

The cruise, taken as a fishing and scientific trip, covered 15,000 miles. Off the Marquesas island colonies of France Pinchot landed some remarkable specimens of skates, large members of the sting ray or devilfish family. After a long fight, an unusually large skate measuring almost twelve feet from fin tip to fin tip was captured and hauled on board by means of block and tackle. It weighed almost 800 pounds. Clear photographs were also obtained of skates swimming near the surface of the sea.

SELF-ADJUSTING CASTER KEEPS TABLE LEVEL

TABLES cease to wobble when their legs are fitted with a new kind of automatic self-adjusting caster invented in England. A wood-screw attaches each one permanently to the furniture leg. Because of its ingenious construction the caster keeps furniture steady on an uneven floor.

Within the caster is a plunger, which, under the weight of the piece of furniture, descends and slowly forces a few spoonfuls of fluid against the resistance of a ball valve into an air-tight chamber. As soon as the weight is removed, the fluid spurts back and the plunger rises of its own accord. Thus all four casters of a table are kept firmly on the ground, because absence of support from a short leg increases the weight on the others and they sink.



"EXTINCT" PASSENGER PIGEON SEEN ALIVE

RECENT reports that the passenger pigeon, which supposedly became extinct in 1914, may not have perished after all have been given added weight by a scientific observer.

The first reports concerned the observations of two laymen. A Michigan publisher reported seeing a pair of passenger pigeons on the road sixteen miles from his Munising home. From a distance of only ten feet he could plainly identify them by the sheen on the neck and the red eyes. A Traverse City, Mich., physician, driving from Florida observed a flock of about fifteen between [illegible] and Kokomo, Ind. Both men had hunted the birds in the days when they were common and were thoroughly familiar with them.

Now Dr. Philip Hadley, University of Michigan biologist, reports that he himself recently saw a bird that may have been a passenger pigeon, his companion, a veteran naturalist, obtained a better look and positively identified the bird. Doctor Hadley suggests that the species may be returning to the northern peninsula of Michigan, once a famous nesting ground for them.

Science has long considered the passenger pigeon as extinct as the auk or dodo. The last known specimen died in 1914 in a Cincinnati, O., zoological park. Previous to that, the last wild bird was seen near Detroit, Mich., in 1898, according to report.

REAL GAS ENGINE FLIES EIGHT-POUND PLANE

WHEN Canning Godfrey, formerly a pilot in the Royal Flying Corps, wanted a souvenir of his flying days he and his cousin built this remarkable model airplane of seven and one half foot wing span and powered it with a one-eighth horsepower gasoline motor. The machine is almost a perfect reproduction of one of the machines Godfrey flew. It makes flights under its own power, though no pilot, of course, can be carried aboard.

A veteran model maker can appreciate Godfrey's feelings when he first filled the half-pint gasoline tank and set the fragile model free. But automatic controls operated perfectly and the model, after a short flight, landed gracefully without damage. The half pint of fuel will keep the plane in the air for twenty minutes. The total weight of the model, ready to fly, is eight and one half pounds.

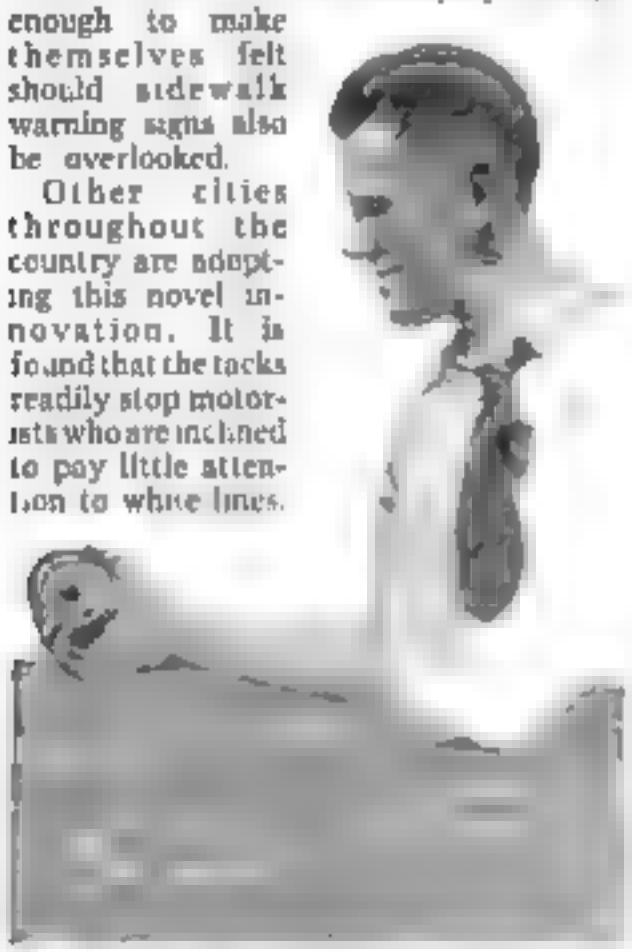
Canning Godfrey shows his seven-foot model of the 1,000-horsepower liner *City of Liverpool*.

"THUMB TACKS" IN ROAD STOP CARELESS DRIVERS

Monster thumb tacks are now being placed at strategic points about the city of Cincinnati. These tacks bump thoughtless motorists who ride over them into keeping their cars as quiet as possible when approaching a hospital or passing through other quiet zones.

The tacks are imbedded in the road while their heads stick up just high enough to make themselves felt should sidewalk warning signs also be overlooked.

Other cities throughout the country are adopting this novel innovation. It is found that the tacks readily stop motorists who are inclined to pay little attention to white lines.



Thumb tacks placed in roadways serve as warning to drivers who ignore white lines.

LOCOMOTIVES USED TO FIGHT FIRES

R dway locomotive equipped to fight fires by pumping water at high pressure from its tender tank. In photo, the engine is seen throwing water over flaming coaches in a test

Engineers of the Chicago, Milwaukee, St. Paul, and Pacific Railway have also become fire-fighters, their new job resulting from the installation of fire-fighting apparatus on switch locomotives.

High-pressure hose lines operated by powerful pumps fed from the water tank in the tender, are the feature of the equipment. It is expected to give valuable aid in fighting blazes along the railroad right of way. The locomotive fire engines were tried out successfully on a trial blaze of old railway cars.

MOTORCYCLE GIVES GLIDER SEND-OFF

A motorcycle was used recently to launch a motorless plane. The glider, towed at the end of a 150-foot rope, rose into the air as soon as sufficient speed was attained. When the cable was released the glider made a successful flight, with the president of the University of Detroit Glider Club at the controls.

The launching was described by the glider pilot as the smoothest he had experienced. Automobiles, airplanes, and motor boats have been used to give soaring planes a start, though of course, in the vast majority of cases, a shock cord, in the hands of a number of men, is drawn taut and in response to this the glider rises into the air, the cable automatically dropping off. This experiment with a motorcycle indicates that, where the terrain permits, the use of man power may be displaced by the more powerful machine which it is expected will give a smoother and more certain send-off.

How a motorcycle rider towed a glider at the end of a 150-foot rope until the plane rose into the air. Above, the glider is up and the towline has dropped clear

CAMERA ON ROCKET GETS HIGH ALTITUDE PHOTOS

The camera is inserted in rocket, powder added, and then set off to get sky photos.

A veritable flying camera is the invention of a twenty-three-year-old German student at the Hindenburg Polytechnic Institute. When he wanted to take pictures from a height of a quarter-mile or so above the ground, he had this novel rocket built at a nearby fireworks plant and equipped it with an automatic camera. It snaps photos of its own accord while the rocket whizzes through the atmosphere. A protective device saves the camera when the rocket falls.

GIANT HARROW IS 65 FEET WIDE

Tractor powered, the world's biggest harrow is being used on an Oregon ranch near Wasco, where steep side-hill fields are not uncommon. The huge drag is sixty-five feet wide to sixteen sections.

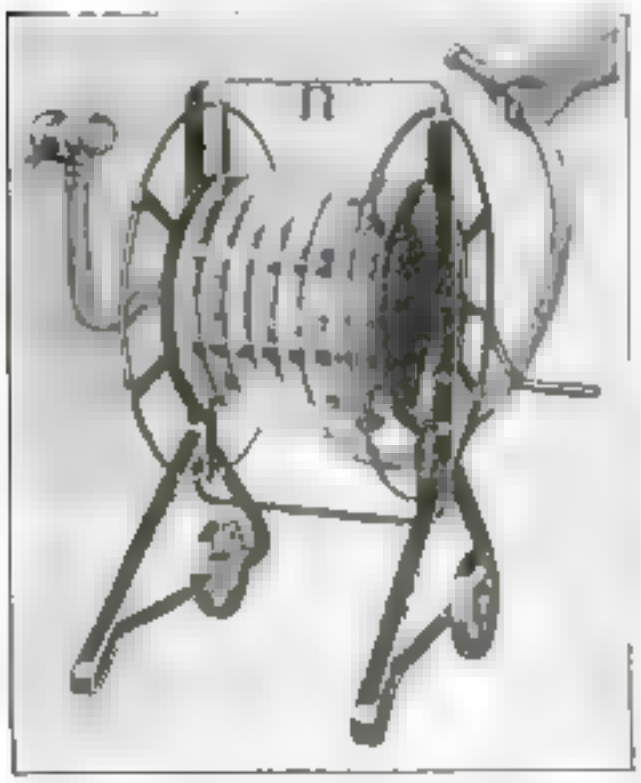
A GIANT among agricultural implements, this enormous harrow recently went into service on a Wasco County, Ore., ranch to prepare the ground for wheat-growing. It measures sixty-five feet from end to end. Hills have no terrors for it, since the tractor-drawn implement can cultivate on a slant

SIX ASTROLOGERS FAIL TO MEET SIMPLE TEST

"ASTROLOGERS" try to read an individual's future from his birth date. How well six of them succeeded in doing this is reported by Dr. Walter F. Prince, of Boston, Mass. No two of these astrologers agreed about a certain man on any point In everything they guessed ninety per-cent wrong.

FAUCET HOOK-UP EASY WITH NEW HOSE REEL

IT IS unnecessary to unwind the entire length of hose from a new hose reel to make the connection between the nipple and the water faucet. A hole in the center of one side of the reel allows the nipple end and about six feet of hose to be carried through. The connection can be made and only as much hose unwound at the nozzle end as one needs

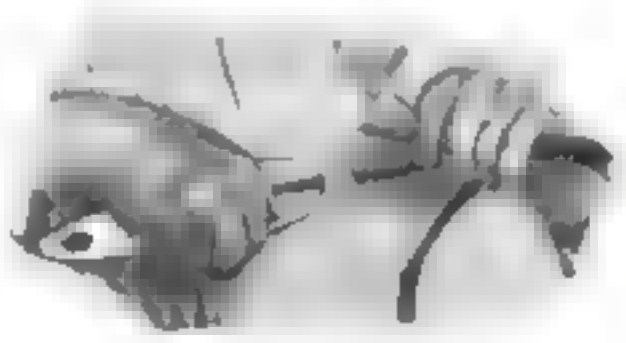


The end of the hose to be attached to the water faucet comes out at the side of this new reel

WIRE-STRIPPING PLIERS REMOVE INSULATION

A STRIPPING device on the handles of pliers recently put on the market can be used to scrape insulation from an electric wire

The improved plier can also be used to scrape the wire-end, leaving it ready for contact The plier ends allow the jaws to bite into the insulation, but not to cut into the wire. Twisting the plier once or twice around the wire severs the insulation, and it can be easily removed.



Stripping insulation from wire is easy with these pliers, which have a device to do this

BLIMP LANDS ON SHIP'S DECK FOR PASSENGER

AS THE first lighter-than-air "feeder" to pick up a passenger from an ocean-going steamship before it docks and bring him to port, the Goodyear blimp *Mayflower*, recently made aerial history in New York Harbor

While the liner *Bremen* lay in quarantine waiting to steam to its pier at Brooklyn the 50,000-cubic-foot, silver blimp circled overhead and then settled down on the small mattress-protected after deck of the vessel. Thirty members of the *Bremen's* crew steadied the airship, and Paul W Litchfield, president of the Goodyear Tire and Rubber Company, climbed into the gondola.

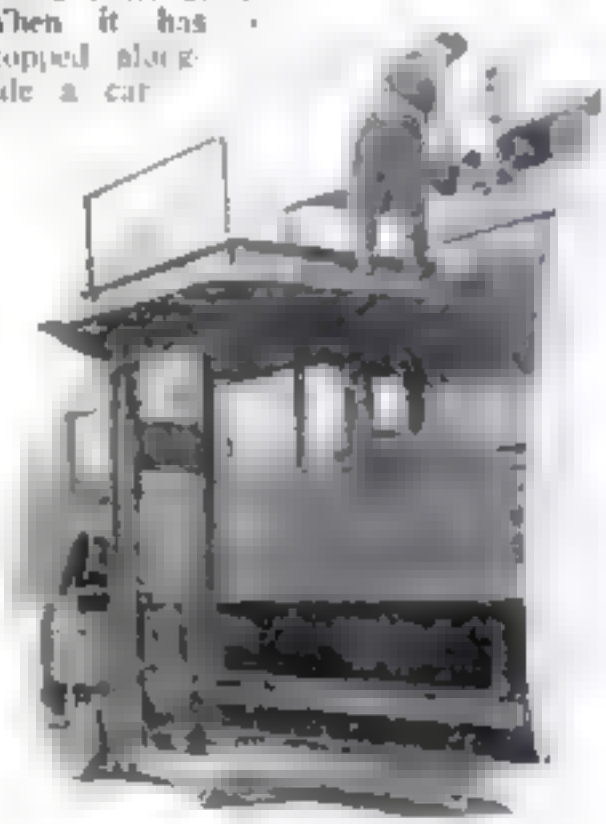
With propellers humming, the motored gas bag sailed away. Litchfield was able to arrive at his hotel in New York City an hour before his sons, who came ashore in the regular manner

MECHANICAL ICEMAN NOW GIVES ICE TO DINING CAR

A MECHANICAL iceman now takes the place of four to six men with ladders and pails who formerly loaded dining cars of the New York Central Railroad with ice

The new device is a speedy electric truck that rolls down the train platform at eight miles an hour, bearing seven 400-pound cakes of ice

When it has stopped along side a car



Refrigerators on dining cars are now filled by this truck which has an elevator attachment

the ice platform rises like an elevator until a man standing on it can easily drop chopped pieces of ice down the receiver in the roof of the car

Bigger pieces are loaded through the side doors of the car, with the platform brought down to the proper level The first of the new "mechanical icemen" was recently placed in operation in the New York Central yards at Buffalo, N Y

The blimp *Mayflower* made history when it landed on the deck of the *Bremen*, picked up a passenger, and carried him ashore.

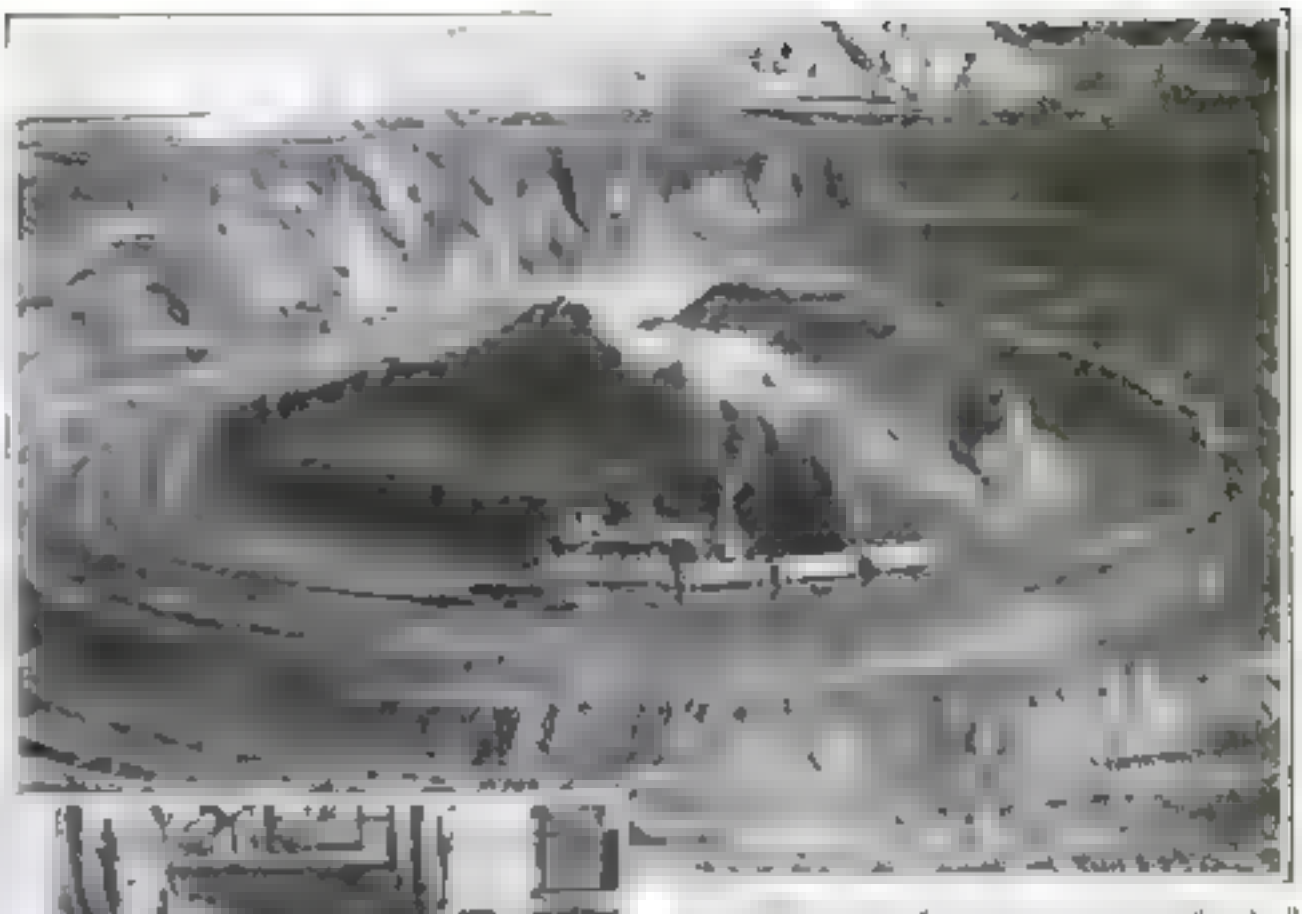
ELECTRIC SHOVEL GRABS 15 TONS AT A BITE IN IRON MINING

FROM the appearance of the p[illegible] at the right, this curious scene might be a miniature model with a t[illegible] train, but it is actually one of the larg[illegible] of the huge iron mines in the region of northern Minnesota and Wisconsin known locally as "The Range." The [illegible] photograph shows just how "open pe[illegible] mines supply a large part of the iron t[illegible] converted into steel, goes into bridges and skyscrapers.

Though most persons think of a [illegible] as a deep, narrow, shaft, these mines are worked in the open air. Their ore is reached by a process known as "strip[illegible]ping." A shallow covering of earth is removed, laying bare the ore, which is loaded on cars on a circular railroad to be brought to the outer level

Giant electric shovels, a recent invention which is revolutionizing this type of mining, are now displacing steam shovels for loading the trains. A typical 1 100-ton monster illustrated here snatches up a fifteen-ton mouthful and reaches out in a circle whose diameter is as long as a city block. If necessary, it could raise its bucket as high as a ten-story building

On its arrival at the surface the iron ore goes through the "washing shed," where it is washed and sifted to remove foreign substances. Then trains carry it to the ore docks at the head of the Great Lakes, whence it is shipped to foundries



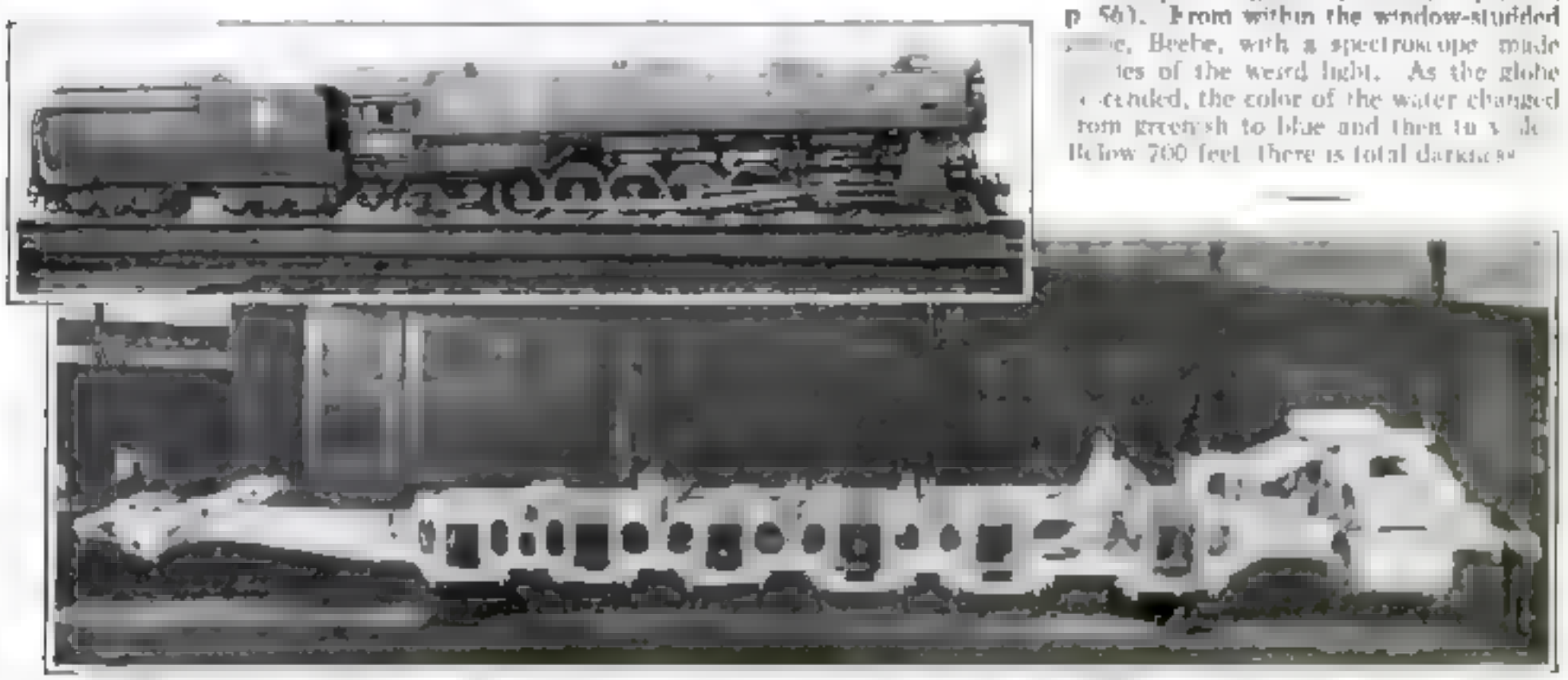
This mammoth stripping shovel digs 15 tons at a bite

BIGGEST ENGINE FRAME IN ONE PIECE

WHAT is said to be the largest one-piece locomotive frame in the world has just been rolled out at a Granite City, Ill., foundry. Some idea of its size is gained by comparing the figure of the man standing at the right-hand end in the picture

The monster frame measures sixty feet from end to end and weighs 82,000 pounds. It will be used in the first of an order of twenty-five high-speed freight locomotives for the Union Pacific Railroad

Making the whole frame in one piece is heralded a triumph of modern steel [illegible]ing. Since even the cylinders are integral with the frame, the locomotives will have fewer parts requiring adjustment in service. This results in greatly reduced operating costs and is expected to add to the life of the engine



This sixty-foot skeleton of a great locomotive is cast all in one piece, including the cylinders. When the engine is finished it will look like the giant seen above and will be one of twenty-five that the Union Pacific Railroad will use in hauling trains of freight

VIOLET LIGHT IS ALL SEA GETS 700 FEET DOWN

FAR below the surface of the sea, an observer sees a scene illuminated in violet light. William Beebe, New York explorer, described this light, in a recent report to the New York Zoological Society

Beebe and a companion made a record 1,426-foot dive off the Bermuda coast in a steel globe invented by Otis Barton, Philadelphia engineer (P.S.M., Sept. '30, p. 56). From within the window-studded [illegible], Beebe, with a spectroscope made [illegible]ies of the weird light. As the globe [illegible]ended, the color of the water changed [illegible]rom greenish to blue and then to violet. Below 700 feet there is total darkness

The Architect Builds His Own Home—A Series

Build in Haste, Repent at Leisure

Is the warning of this Akron, Ohio, expert whose home cost him more than he had planned on. Here he tells you how that happened to him and why, and how you can avoid expensive changes.

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By CHARLES W FRANK

ally is made suddenly Everything then is rushed, including the construction. Costs are often inaccurate and high. The contractor's conception of the house is not clear-cut because the work had not been fully planned before the contract was awarded Consequently, considerable guessing must be done in bidding. In the end, the owner pays more than if he had proceeded systematically and without undue haste

The most fundamental rule that can be followed in building a home is to take plenty of time to study both the preliminary plans and the working drawings and specifications, so that when bids are asked. the contractors will not be forced to guess. The owner should be able, through his study, to visualize the completed project It will then not be necessary for him to go on the job and make changes that bring additional expense

I

I know that because I

And it works

in the house without inconvenience or

AN ARCHITECT, no matter how expert he may be, is after all only human. And so like the layman when he builds his own home, he may change his mind after construction is started and thereby increase the cost beyond his original estimates. I myself recently demonstrated this when I started out to build what I intended to be a small and economical home and ended by having it cost me twenty-five percent more than I had anticipated.

However, such changes as I made resulted in increasing the value of the house more than sufficient to offset the additional expense

The majority of home builders find, though, that the extra money they have spent does not show up in the finished house and therefore represents money

For his own home an architect builds the best house he can design. This is the first of a series of articles in which leading architects in various parts of the country describe the homes they built for themselves. You will find these the most novel and useful articles ever published on housebuilding.

—THE EDITOR.

regret. I am just like everyone else and if I built another residence for myself, I should make some changes. That, however, is true of almost every building that is constructed Regardless of study, improvements are always possible. There are no absolute standards of good taste, for taste is, in a large measure, a question of opinion. I, therefore, do not hold up my house as an example either of a model home or one that is architectually perfect. I do say, however, that the plans as shown are practical for a small family.

IN exterior appearance, the house is fundamentally a cube. That is, the four sides of the main portion are nearly square and the roof is plain, being broken by only one dormer. This is the most economical form that a building can take It gives the maximum of usable space for a given set of dimensions, and at a low relative cost. But such a house is more difficult than other types to make attractive Unless great care is taken in the design an ugly structure will result

By giving attention to details that might be considered superfluous, I tried to make the house pleasing in appearance. The front entrance affords an example. About it is considerable stonework that could have been omitted; but then the doorway would not have been inviting. The wrought-iron balcony on the window directly above the door is another item that might have been left out, but it would have detracted from the appearance. The combined cost of the balcony and extra stonework was not more than $200. I consider money spent for such items well invested

The first floor embodies most of the features usually found in a large residence, but seldom found in a small one. For instance, there are two stairways, a full main stair hal n refrigerating room, breakfast room, pantry, and downstairs lavatory. In order to include these features, I arbitrarily cut down the size of my living room, dining room, and kitchen, but not to such an extent as to impair the practicability of the plan.

Step through the front doorway, and you find yourself in the hallway having a faience tile floor. I put this floor in the main stair hall lavatory, and coat room because these rooms receive direct traffic from out of doors, and accumulate dirt quickly in bad weather

I provided a telephone booth in the coat room to the right of the main entrance. Anyone may use the telephone without disturbing others in the house or without having to turn off the radio or silence other sounds that might interfere with hearing. In small homes such as this, telephone conversations are heard easily in any part of the house. I find that the sound of the bell, being more penetrating than the normal voice, can be heard easily by anyone in any part of the house when the closet door is shut. In fact, I had to muffle it a little.

Rubber floor of a gray and white pattern is used in the kitchen, refrigerating room, pantry, and breakfast room I felt when I built the house and I have learned since, that this material is about the most practical that can be used for the purposes I have mentioned, because it outwears any other material of its nature, is surely much easier to keep clean and is also attractive in its appearance.

Plans show the first and second floors of this model small home into which are incorporated most features usually found in large houses.

A refrigerating room is, perhaps, not essential in a home, but it is an important convenience. Experience has shown me that to have your refrigerating plant right in the kitchen is a mistake. It might save a few steps a day, but the heat from cooking and from the kitchen radiator keeps your refrigerator working overtime. A small room for the refrigerator, immediately adjoining the kitchen, also makes a splendid place for cold storage of vegetables, fruits, and other foods.

In a projecting portion of the house, directly to the rear of the kitchen and its adjoining rooms, is a two-car garage. This is convenient, but has the disadvantage of leading directly into the kitchen This can be overcome in a large home, but in a small residence it is the most practical arrangement

THE second floor plan was designed for a family of four—the husband, wife two children, and a servant It has a large owner's bed and sitting room, dressing room, and bath. That comprises what I designate as the owner's suite, and is accessible only through one door to the owner's room. There are two additional rooms with bath, and a maid's room and bath over the garage. In the owner's bedroom is a fireplace, equipped for gas.

The third floor is finished for recreational purposes. It includes, also, a large cedar storage room with drawers and shelves.

The house contains three baths in addition to the downstairs lavatory. In order to get three baths in a house of this size, it was necessary to make them all small. In fact, they are just about the size of a typical hotel bathroom. The advantage of making them of modest dimensions is that you can make them better for a given amount of money than if you built them large. And they are just as serviceable. Each of the baths has a shower built-on fixtures such as soap dishes, and is tiled to the ceiling

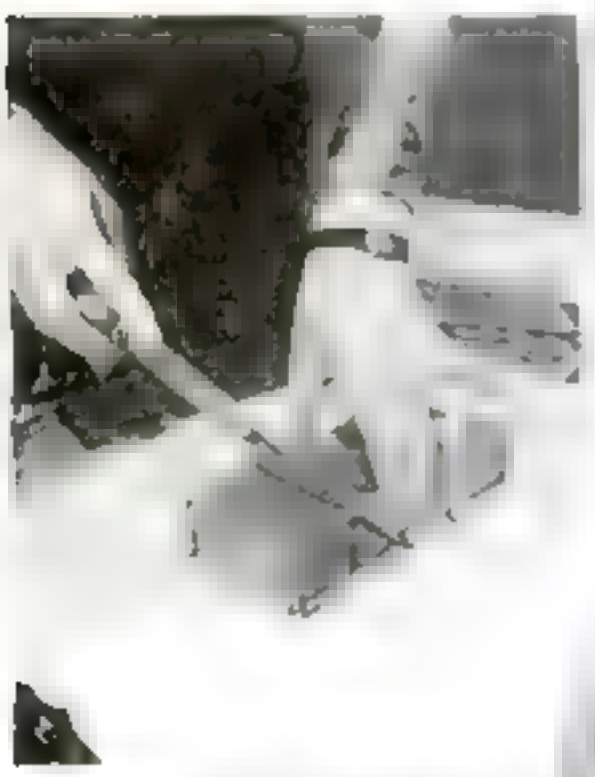
The house has a basement, but I have not mentioned *(Continued on page 148)*

At the right of the living room fireplace is a built-in bookcase Directly beneath the large lamp is a panel in the wall that gives ready access to the plumbing when any repairwork is necessary

A single dormer as seen at the right interrupts the ness of the roof Such a plan makes for simplicity and economy On this house shingles of copper were used.

Easy New Ways to Do Old Familiar Household Jobs

RUBBER NUT FIREPROOF. By a special ... dishes of hard rubber are held ... and come in attractive colors



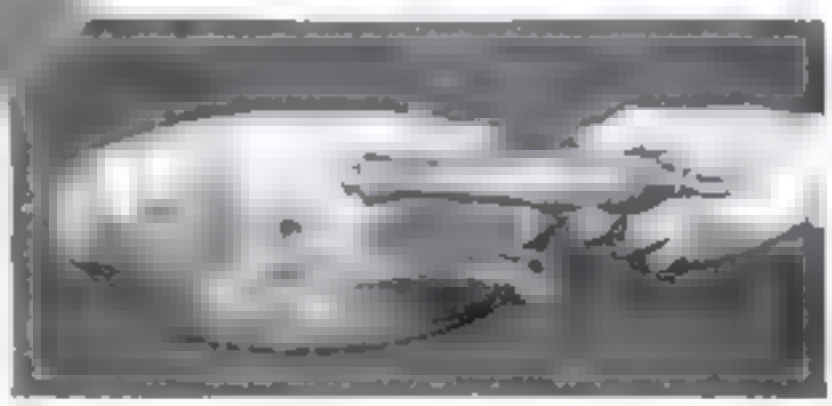
HANDLE LIFTS THE LID. To raise the cover of this all metal coffee pot, just snap loose the hinged handle. The pot's top contains a vacuum.

MEASURE YOUR BUTTER. No longer do housewives have to guess at the amount of butter or lard they use. Slits in the measure give right amount.

NOT A MEAT CHOPPER. This handy tool is not what it appears to be. It has interchangeable drums one of which slices apples or potatoes while the other crumbs bread or can be used to chop cheese or nuts.

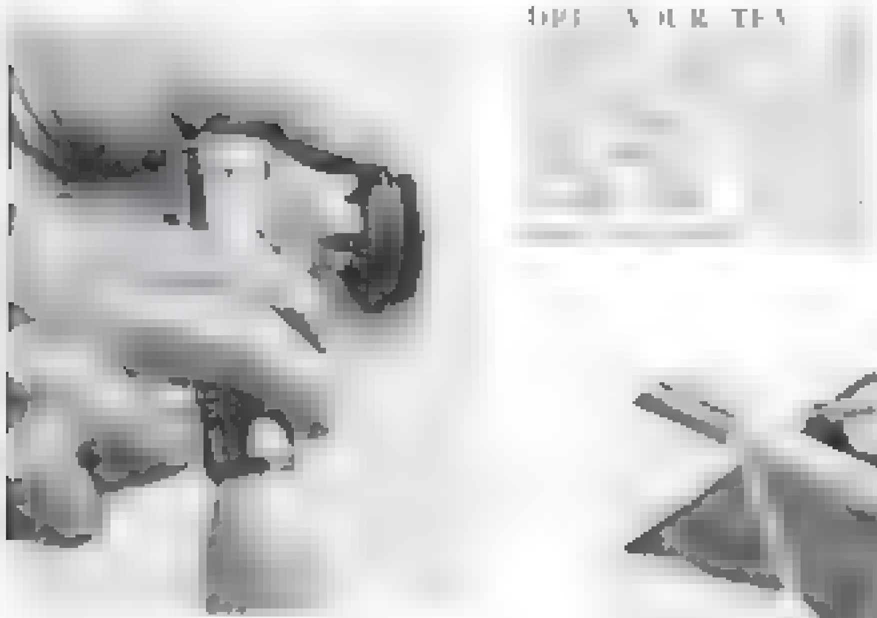
NO SPOON IS NEEDED. This ingenious device stirs the contents ... by lifting handle which ...

WATCHDOG OF THE ICEBOX. This thermometer, placed inside your refrigerator, tells you if the temperature is right to preserve foods. A red mark indicates the 50 degree danger line.

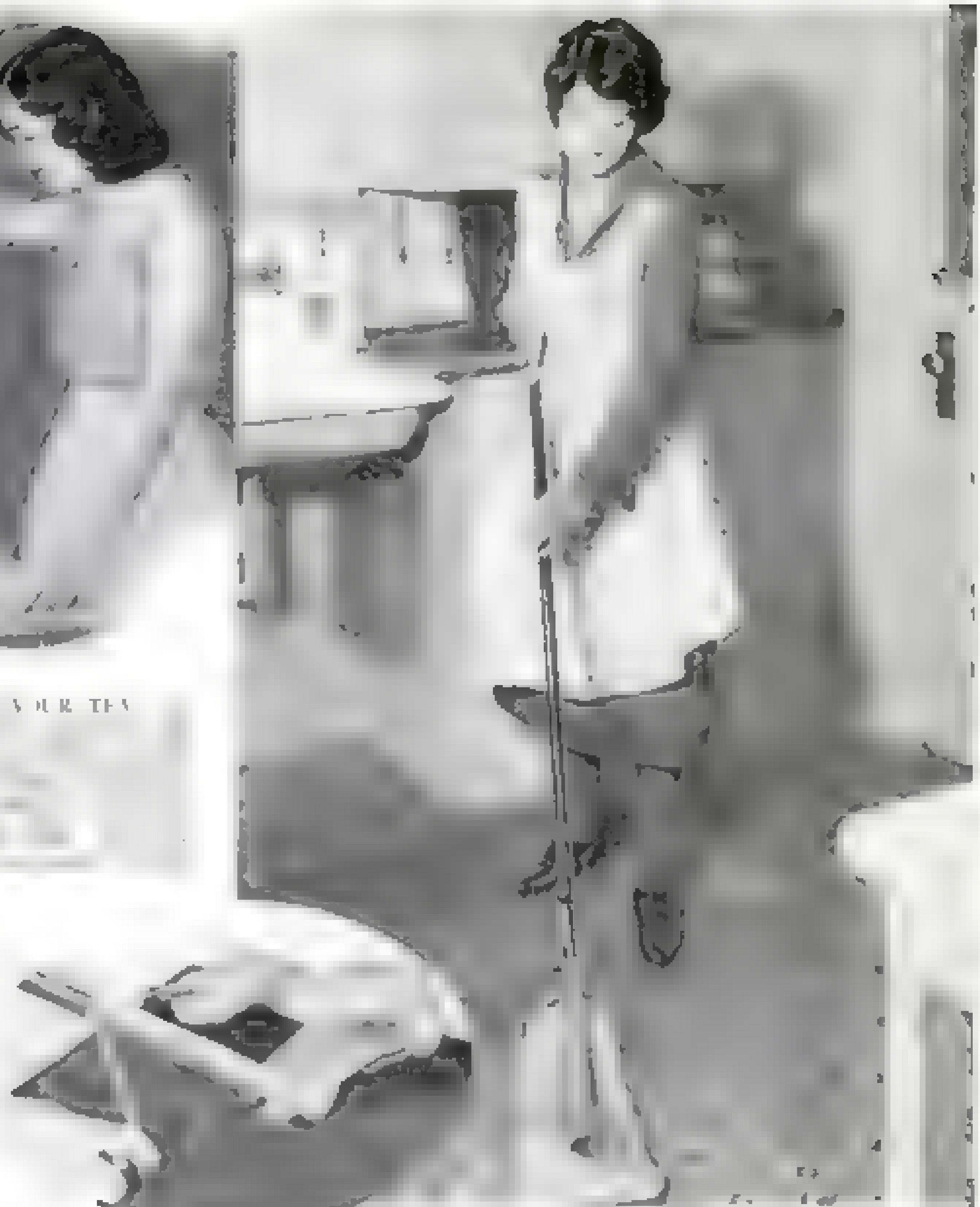


SKILLET GOES IN OVEN. The handle of this aluminum dish is removable, which makes it possible to bake in it without crowding other utensils out of the oven.

DRY YOUR TEA

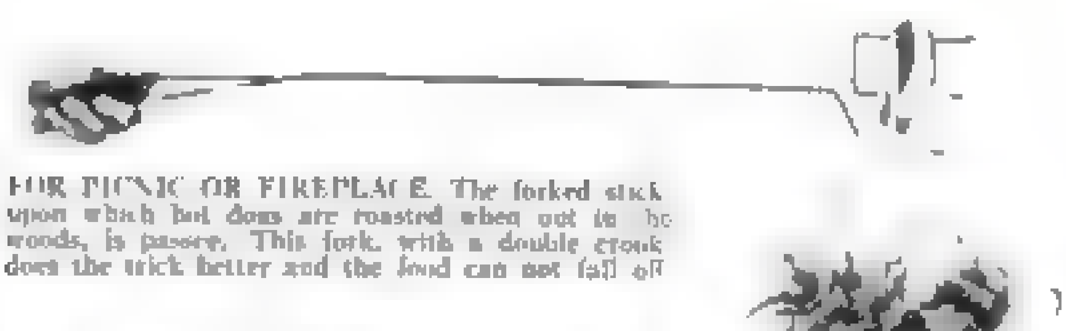


IT'S SUCTION DOES IT. The bathroom wall is not disfigured by

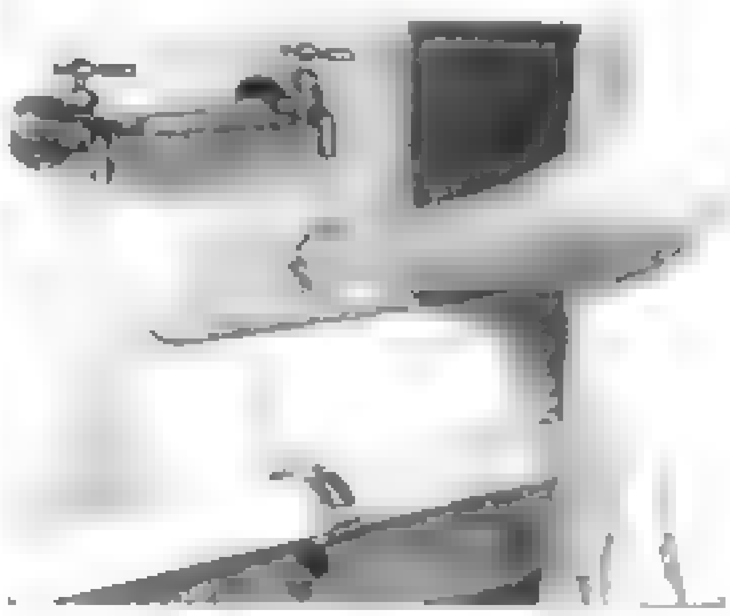


NO METAL TO MAR WOODWORK. This improved floor cleaner is designed to mop right up to baseboards or furniture as there are no exposed metal parts. Inset shows lever that quickly wrings mop dry without touching it with the hands.

SHREDDED FOR BABY. Just enough vegetables for the little one's meal can be shredded in a jiffy with this perforated metal sieve which fits over glass dish. A spatula to force vegetable through the mesh comes with the set.



FOR PICNIC OR FIREPLACE. The forked stick upon which hot dogs are roasted when out in the woods, is passe. This fork, with a double crook does the trick better and the food can not fall off



STOPS SPLASHING. This metal shield, clamped to the edge of the sink, keeps the water from flying all over you and makes unnecessary the use of a rubber apron. When not in use to protect your clothes and the kitchen floor, it can easily be slid out of sight beneath sink.

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Is It a Sporting Chance?

WITH characteristic energy and thoroughness, a group of multi-millionaires have set about the business of defending the America's Cup in the series of races with Sir Thomas Lipton's latest yacht.

Unlimited financial backing has made it possible to commandeer the finest of materials and the greatest of nautical architects in the building of four racing yachts, the *Weetamoe*, the *Yankee*, the *Whirlwind*, and the *Enterprise*. The engineering skill that has gone into the job may be judged by studying the drawings on page 30.

POPULAR SCIENCE MONTHLY is, of course, only interested in the scientific aspect of the building of these yachts. From this point of view, we believe our readers will agree that the expense seems justified.

However, it occurs to us that many sportsmen in this country will feel that it is hardly sporting to mass such an aggregation of brains and capital against Sir Thomas's single craft. Only one of the four American yachts will race yet that one will represent, in effect, the best of four attempts to build a speed yacht.

Wouldn't it have been a bit more sportsmanlike for the American backers of yacht racing to pool their resources and take a sporting chance on the production of a single yacht to race a boat that crossed the ocean under its own canvas?

Your Eye Beats the Camera

IN CERTAIN ways the human eye is far better than the finest of cameras. In others, the camera is far superior. The lens in the human eye is, for example, a crude piece of mechanism as compared with a fine camera lens. The camera lens sees objects over a considerable area with uniformly good definition. The lens in the human eye, on the other hand, is so crude optically speaking, that it would be almost useless if the retina of the eye were flat like a photographic plate.

However, the eye is better than the camera in visual acuity which means the sharpness and accuracy with which things are seen. Within a small area known as the center of visual acuity, the human eye sees things with truly marvelous precision. Minute detail that would be lost in the relatively coarse grain of the photographic plate is quite clear to the eye.

It is this difference between eyesight and camera sight which makes the picture contest on pages 24 and 25 so interesting. The camera sees everything within its field of vision with approximately equal definition or sharpness, whereas the human eye must turn and shift about so as to make the center of visual acuity cover every portion of the picture. Things that the camera has been made to see wrong—trick photography, in other words—are not seen by the eye unless it centers on each one individually. Even then they won't register on the brain as errors unless mental alertness signals that something is wrong.

S O S of Prevention Now in Use

JUST twenty-one years ago, January 23, 1909 radio waves carried the first distress call from the high seas. In the wireless cabin of the rammed and sinking *Republic*, Jack Binns sent out his famous "CQD" call for help and neighboring vessels rushed to the rescue.

As a life-saving instrument, radio has come of age. Its twenty-one years of service have been packed with achievements in response to calls for help in time of disaster. Now it has turned to preventing disasters as well as summoning aid when they occur. Turn to page 22 and read how complete weather maps are being sent by wireless to ships at sea, enabling captains to avoid storms and thereby increase both the comfort and safety of passengers.

Bravery That Means Progress

SINCE the beginning of time men have been braving sudden death in various forms. Cave men were continually forced to risk their lives in combats with animals and with each other.

Modern civilized men, perhaps because of inherited chance taking instincts, continue to flirt with death. In many instances this willingness to face danger is directly responsible for the advances civilization has made.

After reading the article on page 28, we are sure you will agree that testing new types of airplanes comes under this head.

However, the line between commendable chance taking and mere vainglorious foolhardiness sometimes is none too clear. Now that it has been amply demonstrated that an airplane may remain in the air for weeks at a time, it is extremely doubtful if further attempts to beat the endurance record can be classed as anything more than circus stunts.

Certainly there cannot be a single iota of scientific value in airplane stunting close to a ground surface crowded with human beings. The nitwit who does such things displays less intelligence than the pole sitter, the marathon dancer, and the gentleman who goes over Niagara in a barrel.

The Home You Want to Build

THE old saying that the shoemaker always was poorly shod and the tailor poorly clad may have been true in the days when artisans of all types were poorly paid. Modern tailors are, however, regular fashion plates, and the modern chain shoe store manager wears old shoes only if he happens to have corns.

The local builder of olden times, who, with his helpers, did everything from designing the house to laying the foundation stones and carpentering the lumber may have himself lived in a comparatively humble dwelling. The article on page 66, the first of a series on homes built by architects for their own use, conclusively proves that the modern architect usualy lives in a home that may, within its price class be taken as a "fashion plate" a model of what such a house ought to be.

If you are contemplating building a new home or buying one already built, this series of articles should prove helpful.

As any architect will quite frankly admit, his ideas may not exactly fit your requirements or desires, but a study of these articles is sure to show you how to go about satisfying yourself.

Cars Roll Over Racial Fears

THE reader of the article on page 40 will be astounded at the queer customs which interfere with the sale of American cars in various parts of the world. In reality that article is a remarkable record of scientific progress. It proves, for one thing, that the idea of individual mechanical locomotion has now penetrated virtually to all the peoples on earth.

Skins may be brown, red, black, or saffron, religions may be as far apart as the poles, methods of government may be equally diverse, yet the human brains underneath these external trappings are rapidly becoming alike in their yearning for the very latest in mechanical progress.

HELPFUL HINTS FOR RADIO FANS

How Liquid Condensers Work

New Small Units Prove Handy and They Are Self Healing—How to Tune for Best Quality

MOST RADIO beginners are familiar with the paper condensers used to filter out the pulsations in B eliminator circuits. They consist of sheets of tin foil or aluminum foil separated by thin sheets of specially prepared paper. The capacity of such a condenser depends on the area of the metallic foil and the thickness of the paper placed between the sheets of foil.

For two reasons the size of a paper condenser is governed by its capacity and its rated working voltage. Obviously more foil and paper must be used to get greater capacity and the higher the rated working voltage, which, of course, is the highest voltage that the condenser will stand in regular use, the thicker must be the insulating paper

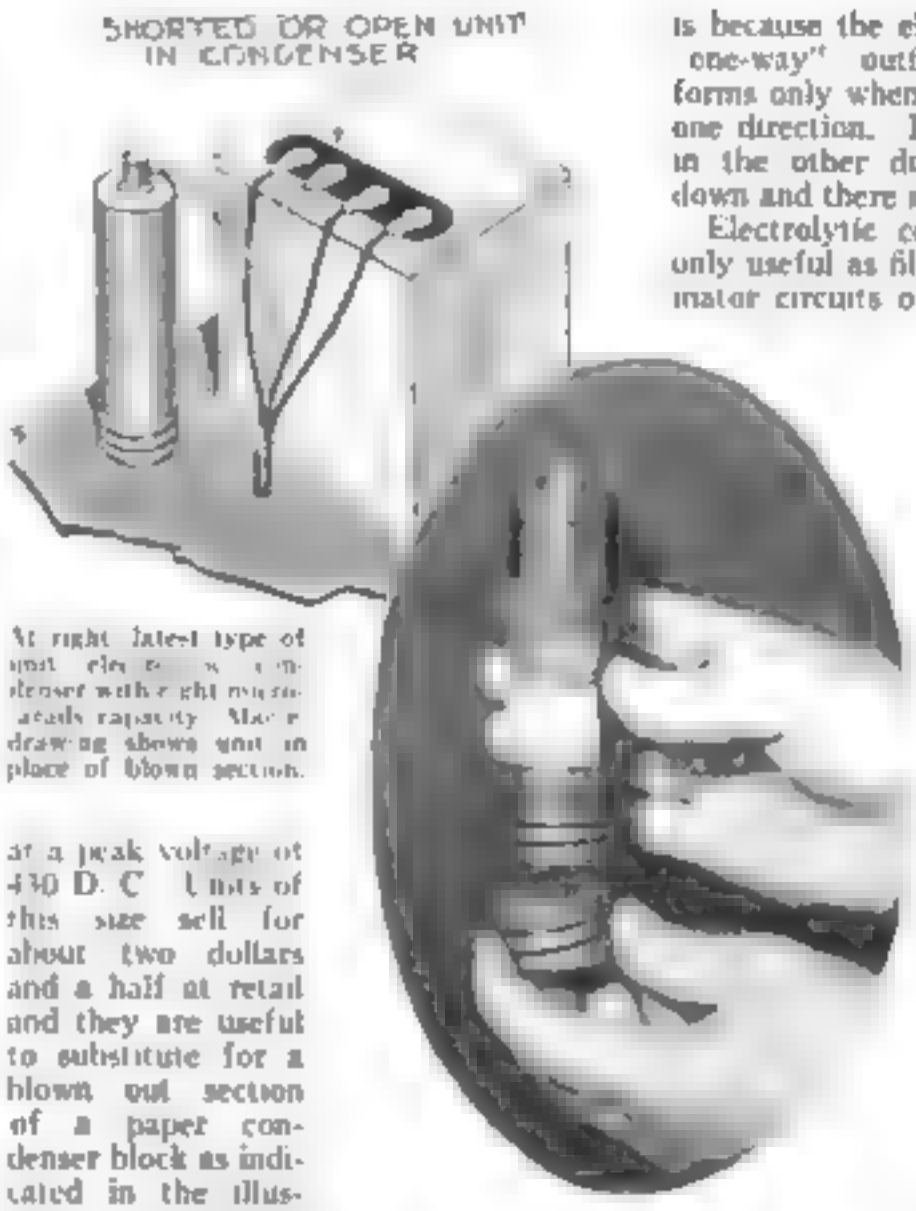
Knowing these facts, the modern electrolytic condenser appears to be a queer piece of apparatus that does not conform to the usual rules. That is because of the principle on which the electrolytic condenser operates Instead of paper, the insulation in an electrolytic condenser is a microscopically thin layer of aluminum oxide which forms on the surface of the aluminum electrode. The plates of the condenser are, therefore, the aluminum electrode and the solution. Contact with the solution is obtained by way of the metallic can which holds the solution and the electrode

ENORMOUS capacity in a small space is possible in the electrolytic condenser because of the thinness of the oxide film. The capacity of any condenser is in proportion to the spacing of the plates, and the aluminum oxide film is many times thinner than the thinnest paper used in the ordinary foil condenser

Early types of electrolytic condensers had many disadvantages. They often leaked solution and their rated working voltage was not high. Now electrolytic condensers have been improved so greatly that it seems likely that more and more manufacturers will use the electrolytic type in place of paper condensers in the filter circuits of the future sets.

One special advantage of the electrolytic condenser lies in the fact that it is self healing. If, by any chance, it is subjected to excessive voltage, a breakdown will occur as with the paper condenser and as long as the high voltage is maintained the condenser will be out of commission. However as soon as the excessive voltage is cut off the insulating film is restored.

The illustration shows the latest type of unit electrolytic condenser. The capacity of this small unit is eight microfarads



At right latest type of unit electrolytic condenser with eight microfarads capacity. Above drawing shows unit in place of blown section.

at a peak voltage of 430 D. C. Units of this size sell for about two dollars and a half at retail and they are useful to substitute for a blown out section of a paper condenser block as indicated in the illustration at the right

As the illustration shows, the bottom of the metal can is threaded and screws into a thin brass socket which can be screwed or riveted to the metal chassis

Electrolytic condensers can be used only on pulsating direct current. This is because the electrolytic condenser is a "one-way" outfit. The oxide coating forms only when the current is flowing in one direction. If high voltage is applied in the other direction, the film breaks down and there is a heavy flow of current.

Electrolytic condensers are, therefore, only useful as filter condensers in B eliminator circuits of a radio set or in other commercial uses where the conditions are substantially the same

Three units of the type shown will give a total of 24 microfarads of capacity at a cost of less than eight dollars. They will appeal to home builders of electric sets or plain B eliminator circuits. A paper condenser block of the same capacity and rated working voltage would take up a lot more room and cost much more money

A B C's of Radio

BECAUSE no two localities are exactly alike, the golden rule for good radio reception is to try different antennas and ground connections until you find the combination that gives best results Not infrequently when two antennas are put up, there will seem to be no difference between them Yet it may happen that the use of both antennas at the same time will effect a noticeable improvement. The same thing may happen when you are experimenting with ground connections. Ordinarily the water pipe is the best ground, but at times a metal plate may be better.

SET TUNING BY TONE

THERE is just one point where any given station can be brought in with best tone quality. That is the point where the dial is tuned squarely on the wave. A fraction of an inch of dial motion either way makes a definite difference in tone quality As the dial is moved away from correct position, the deeper tones become weaker and there is an excessive amount of the higher tones.

That is why a person with a poor ear for music is so likely to tune the set so that the tone quality is not all that it should be.

To get the station with the best possible tone quality, rotate the dial slowly back and forth across the proper setting until you are sure of the point where the tone seems most natural and lifelike. This is particularly important with modern sets fitted with an automatic volume control On powerful local stations, there may be no appreciable difference in volume over several degrees and yet the slight tone changes that occur are quite clear if you listen closely for them, especially if you have a good ear for music, trained to catch fine distinctions.

New Tubes Increase Battery Set's Power

Battery sets using the revolutionary new tubes, which have just been developed, may be housed in these console cabinets with compartment for dry cell battery.

By ALFRED P. LANE

THREE remarkable new radio vacuum tubes recently developed will effect a revolutionary improvement in radio reception in the millions of homes still unwired for electricity.

Many more millions of radio enthusiasts who already have electric sets will be interested in the new tubes because they make possible the solution of a problem that has, up to now, baffled the most expert engineers. The dream of a portable set that would be really light, exceptionally efficient, and economical to operate will, with the aid of the new tubes, soon become an actuality

In the early days of radio broadcasting, all radio sets were battery operated. The city man had no advantage over the man in the country as far as radio reception was concerned

Then came the big demand for radio receivers that could be operated from the electric light socket and engineers concentrated on meeting this demand. Battery operated sets became obsolete. The man who owned one saw his equipment hopelessly outclassed in every detail of performance by the new "electric" sets.

The vital parts of any radio circuit are the vacuum tubes. Electric sets were better than their battery operated predecessors simply because the new tubes designed for alternating current operation were so much more efficient

Now, at last, engineers have turned to battery operated tubes to see what can be done to bring them up to modern standards. The resulting development exceeds the most sanguine expectations. A new screen grid tube has been produced that is close in operating efficiency to the best of the alternating current type screen grid tubes and yet it draws far less current from a set of dry cells than even the much inferior battery screen grid tube it displaces.

Imagine a general purpose tube practically as good as the 201A or 227 that takes only two thirds of the filament power needed for the inefficient and short lived 199! And a power tube with an undistorted output almost equal to the 171A that draws only two thirds as much power from the dry cell A battery as the tiny 120

THE new general purpose battery operated tube, type UX-230, is similar in general appearance to the old type 199 The base is the same but the glass tube is a trifle larger in diameter and a bit longer These two tubes are shown exactly two thirds full size in Fig 1. In the oval appears an enlarged view of the elements with the glass removed The new type 230 appears at the right in each view. Note the larger and more substantial elements in the type 230 as compared with the frail elements in the 199 at the left

Actually, the elements of the 230 tube are like the elements in the storage battery tube type 201A, although reduced somewhat in size to fit the smaller glass bulb

The 199 tube requires a trifle over 3 volts on the filament and draws a fraction over six hundredths of an ampere of current. The type 201A tube requires 5 volts on the filament and draws one quarter of an ampere of current. The new type 230 general purpose battery tube needs only 2 volts applied to its filament, and yet draws no more current than the 199 tube

This means that the new tube can be operated on only two ordinary dry cells instead of the three required to operate the 199. The current consumption being the same in either case, the cost of dry cells needed to heat the filament of the new tube is only two thirds of that required for the 199 tube. Or, if both types of tubes were used on three dry cells, the useful life of the cells when operating the 230 tube would be considerably longer than with the other tube because they could be used to a lower minimum voltage

In the electrical characteristics which govern the efficiency of the tube for radio reception, the type 230 closely approximates the results obtainable from the 201A battery tube which is, in turn, about equivalent to the 227 A. C heater tube used in the latest electric sets. The amplification factor of the 230 is 8.8

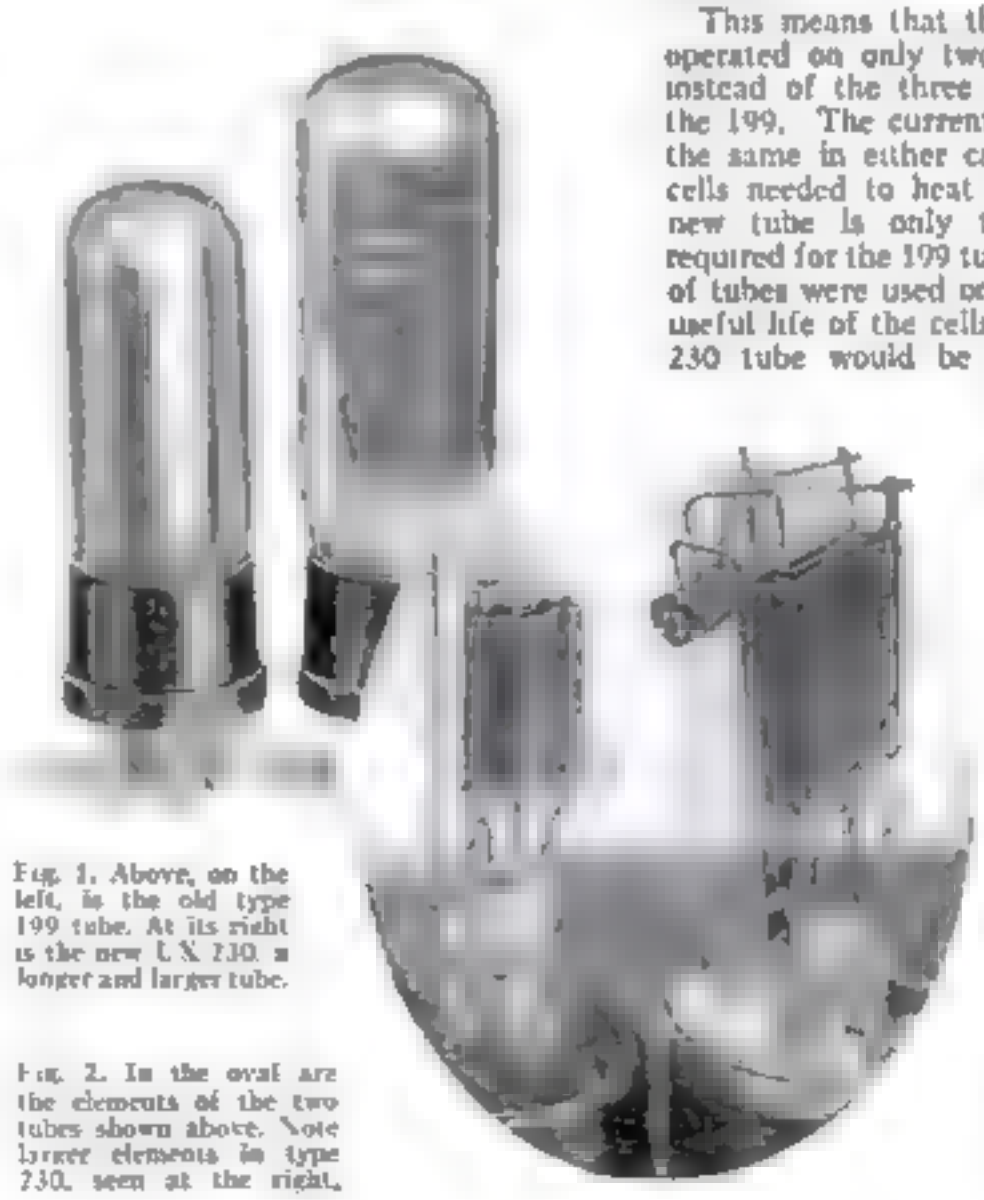


Fig. 1. Above, on the left, is the old type 199 tube. At its right is the new U X 230, a longer and larger tube.

Fig. 2. In the oval are the elements of the two tubes shown above. Note larger elements in type 230, seen at the right.

as compared with 8 for the 201A tube and only 6 for the 199

When used as a radio or audio frequency amplifier, the 230 tube draws a fraction less current from the B batteries than does either the 201A or the 199.

IN SHORT, the new 230 tube is about on a par with the 201A and 227 tubes for reception results and costs only two thirds as much as the 199 for A battery power That is a notable improvement, and users of older types of dry cell operated sets will be glad to know that the 230 tube can be substituted without important change in the set, in any receiver designed for the 199 tube. The substitution will cause a marked improvement in reception, although of course not as much as if the circuit is especially designed to take advantage of the new tube's better electrical characteristics.

In the new types of battery sets designed around these new tubes, the 230 probably will be used as detector and first stage audio amplifier

In the radio frequency stages, however, the new type 232 screen grid battery tube undoubtedly will be universally used This new tube is shown with the type 222 the old battery operated screen grid tube, in Fig 3, two thirds full size

The improvement, both in electrical characteristics and in economy of operation, is much greater, even, than in the case of the 230 general purpose tube. The filament voltage of the new tube is only two volts as compared with a trifle over 3 for the old 222 and the filament current consumption is but half that needed to operate the 222.

While the construction of the elements in the new 232 tube is not exactly like the heater type screen grid tube designed for alternating current, that is, type 224, the 232 is nearly four times as efficient as the old 222

Summing up the advantages of the new 232 battery type screen grid tube, we find

Fig. 3. At the right is the new type 232 screen grid battery tube and at its left is the old type 222 which it replaces.

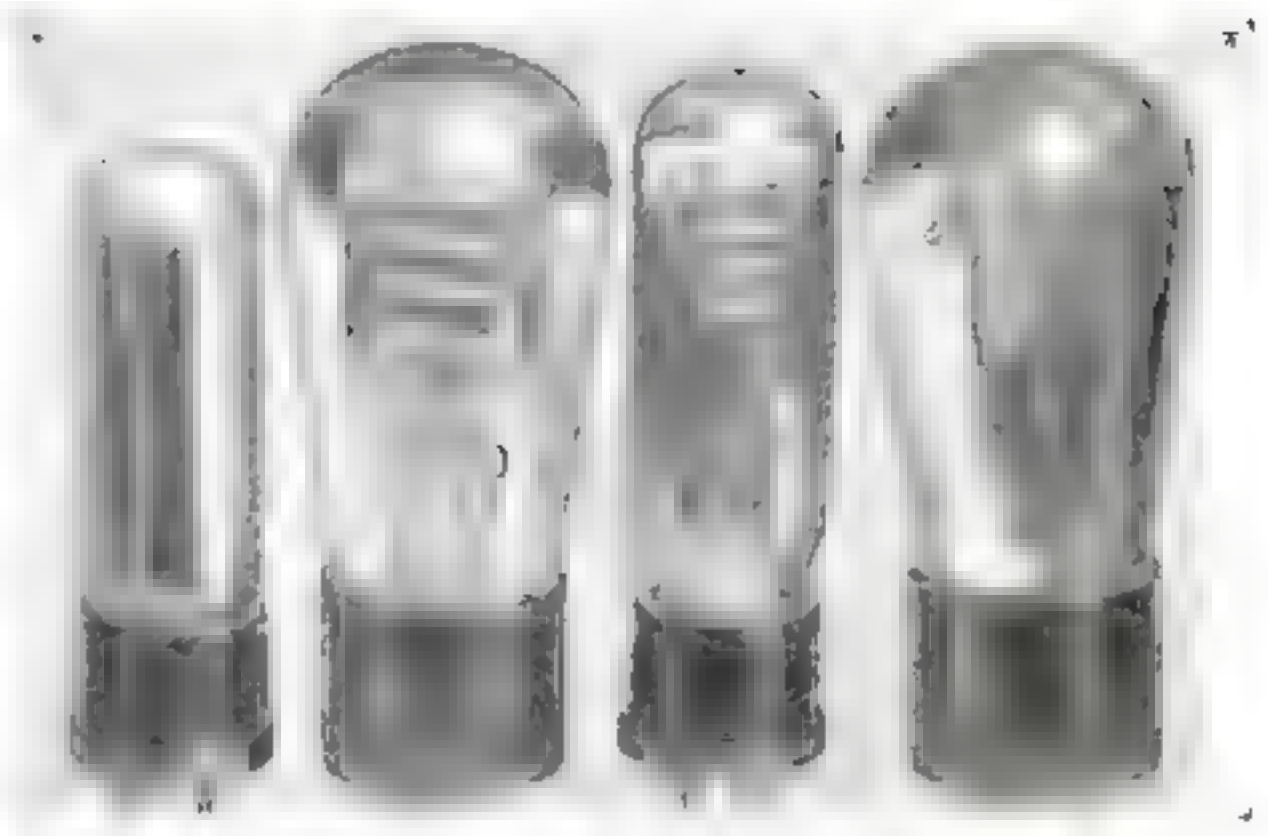


Fig. 4. From left to right the tubes above are the old 120 type, the 112A storage battery tube, the new 231, and 171A. Position indicates their relative power handling ability.

that it is far more efficient for radio reception and costs less to operate than the former battery type screen grid tube.

The third member of the new group of battery operated tubes is the type 231 power tube. This tube is shown in Fig. 4 two thirds full size. From left to right the four tubes are the old 120 battery type power tube, the 112A storage battery power tube, the new 231, and the well-known 171A power tube so popular for use in both battery operated and electric type sets. The tubes are arranged in this order to indicate their relative power handling ability. The new type 231 has a greater undistorted output than either the 120 or the 112 and is only slightly inferior to the 171A when operated at the same voltage.

It also operates on volts applied to the filament, but the filament current is a trifle over twice that needed for the new 230 general purpose tube. The required B and C voltages are the same as for the old 120 tube; in other words, B voltage, 135; C voltage, 22½.

For the benefit of radio fans who wish technical data in table form, here are the specifications of the new tubes

Filament voltage	2	2	2
Filament current (amperes)	.06	.06	.132
Plate voltage	90	135	135
Plate current (milliamperes)	1	1.5	5
Screen grid voltage		67.5	
C bias voltage	4.5	4.5	4.5
Amplification factor	8.8	440	3.5
Undistorted Output		milliwatts	170

A feature of the new tubes that will be much appreciated is their ability to stand knocks and bumps without producing sounds like the twanging of a guitar They are far less microphonic than the old dry battery tubes which they will displace.

As already mentioned the new 230 tube can be used in any set designed for the 199. Similar replacement is possible with the other two new tubes. The 232 can be used in place of the 222 and the 231 will take the place of the 120. All the new tubes are fitted with the X type base so it is not necessary to change sockets If it is desired to substitute the 232 screen grid tube for 222 tubes in a 6-volt storage battery operated set a 50 ohm fixed resistor should be inserted in the negative wire to the filament. This will reduce the current flow to the proper value and, if the grid return is changed to the battery side of the resistor, the necessary increase in C bias also will be provided for

No output transformer is needed with the 231 power tube as the plate current 8 milliamperes, is not great enough to injure the windings of any ordinary loudspeaker

IT IS not known at present how many radio manufacturers will bring out special battery operated sets designed to make the most of the new tubes, but it is safe to say that there will be several during the next few months.

Probably these sets will be housed in the popular console cabinet with special compartments for the dry cell battery supply, perhaps along the lines of the outfit which appears in the illustration at the top of page 70

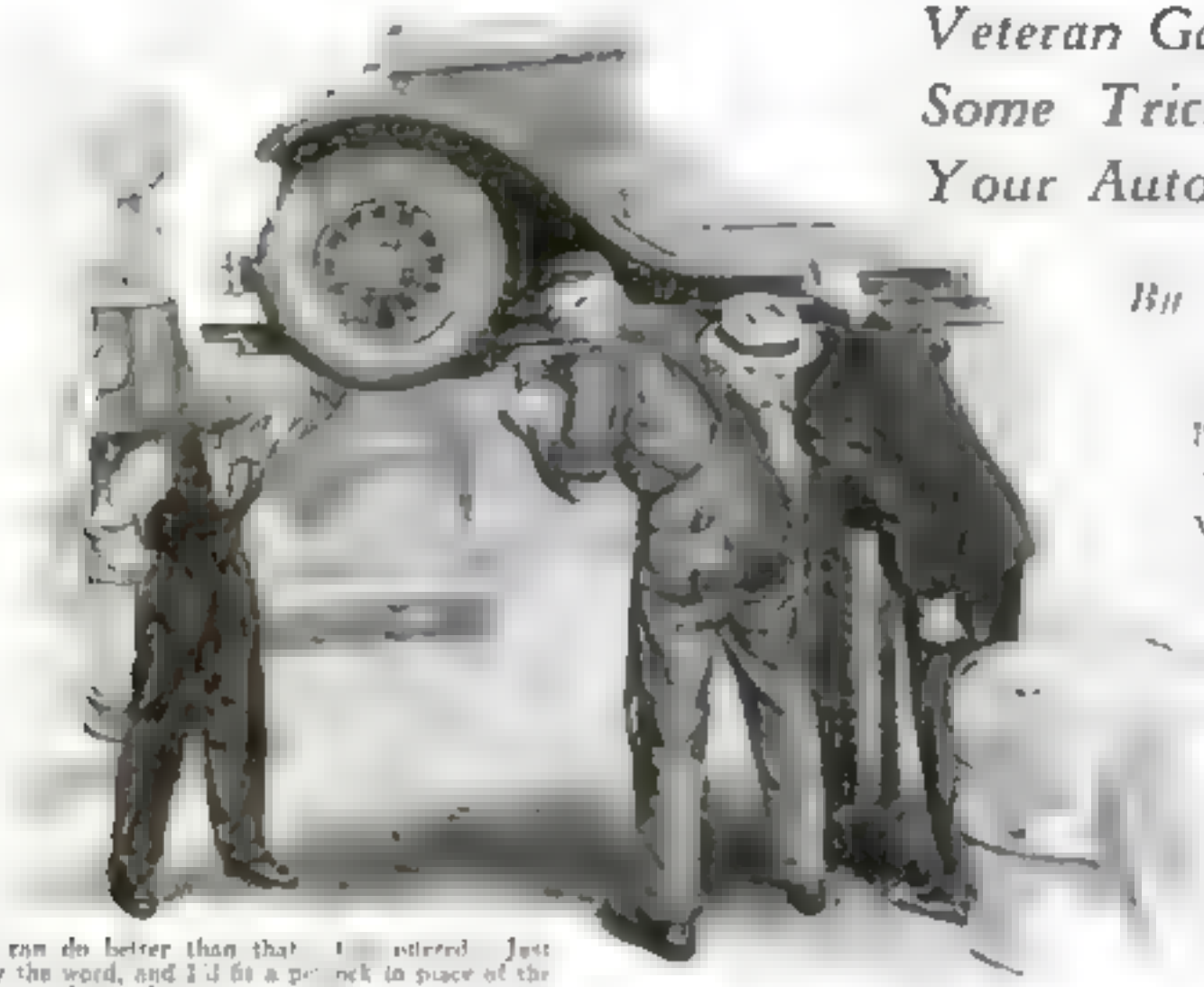
It is quite likely that several of the larger storage battery manufacturers will bring out special, small single cell batteries designed to supply the filament current for sets using these new tubes. Such batteries will appeal to battery set users who are situated not too far from a battery charging station. Because of the small size and light weight of these special batteries, it will be easy to carry them in to the service station for charging.

It is estimated that about twenty per-cent of the homes in the United States still remain unwired for electric light current. If you happen to live in one of these homes, the new battery tubes are bound to improve your radio reception and materially reduce the cost of operating your radio set

Grease and Stay Clean, Says Gus

Veteran Garage Man Reveals Some Tricks in Lubricating Your Automobile Efficiently

By MARTIN BUNN



"I can do better than that," he offered. "Just say the word, and I'll fit a petcock in place of the oil pan drain plug so you needn't use a wrench."

"SEE THE beautiful country by motor!" Madison muttered jeeringly to himself as a fresh gust of wind dashed a torrent of rain against the windshield. "Three days out and three days of rain. See the beautiful country! I've seen about as much as you could see out of a submarine! Now all I need is a real good break-down or a first class smash-up to make this vacation a perfect flop—and if I don't get this steering gear fixed pretty soon that's just what'll happen to me."

Madison swore gently to himself as he yanked the wheel to round a curve in the road. A mile or two farther on, the rain stopped and he caught sight of the Model Garage.

"Steering gear's on the bum. It's almost impossible to turn the wheel," he growled as he pulled in.

Gus Wilson, veteran auto mechanic and half owner of the Model Garage, twisted the wheel back and forth a couple of times. It groaned protestingly.

"Dry as a bone," he commented. "Run it over here where I can shoot it up in the air and give it a good greasing."

"Say listen, mister," Madison snapped disgustedly, "I had it greased last night at the garage where I stopped over. Can't you see the grease smeared all over the fittings? Guess again!"

Gus chuckled. "That's an old one. They knew you were just passing through so they spent two minutes dabbing grease on the fittings that show and let it go."

"Stung again!" exclaimed Madison. "The tourist hasn't much chance these days, has he?"

"It isn't as bad as that," Gus replied, as he turned the valve and the car rose from the ground. "Most of 'em wouldn't do a trick like that."

"Well if I've got to watch 'em to make sure," said Madison, "I might just as well do the job myself. I started to when I first got the car but the grease gun busted. It's awful messy, though. I got grease all over everything the last time I tried it."

"Why get all smeared?" Gus asked. "Take more time and do it right.

"In the first place," Gus continued, "you want a grease gun that shoots grease or oil out where it is supposed to come out and not out around the handle and every joint. Next, squander two bits on a pair of leather-faced canvas gloves with gauntlets—the kind they sell to truck drivers. Then make a raid on the rag bag and get a good wad of clean rags. Put on the gloves and keep 'em on all you get through."

"But I can't work with gloves on," Madison objected.

"Sure you can," Gus asserted. "After you've done the job a few times with gloves on you'll get the habit and when the gloves get so greasy it starts to work through on your hands, throw 'em away and get a new pair.

"Here's another point where you win out by doing the job yourself," Gus added as he reached for a clean piece of waste. "You'll notice that I clean off every bit of dirt from each fitting before I shoot in the grease. Lots of service stations are mighty sloppy about that. They just shoot the grease in and the dirt along with it and believe me, that grit doesn't do the bearing surfaces any good. If you do the job yourself, you can take the time to get the dirt off."

"How often ought I to do the job?" Madison asked.

"Stick to the oiling chart that came with the car," Gus suggested. "Of course if you're running a lot through mud in summer or slush in winter oil the bearings that get splashed about twice as often. That will keep the water out of 'em."

"When you get through there," said Madison, "you can sell me a good grease gun. And can you sell me a wrench that will really fit that plug in the oil pan so I can drain the crankcase myself? I nearly ruined a couple of knuckles the last time I tried it with a regular wrench."

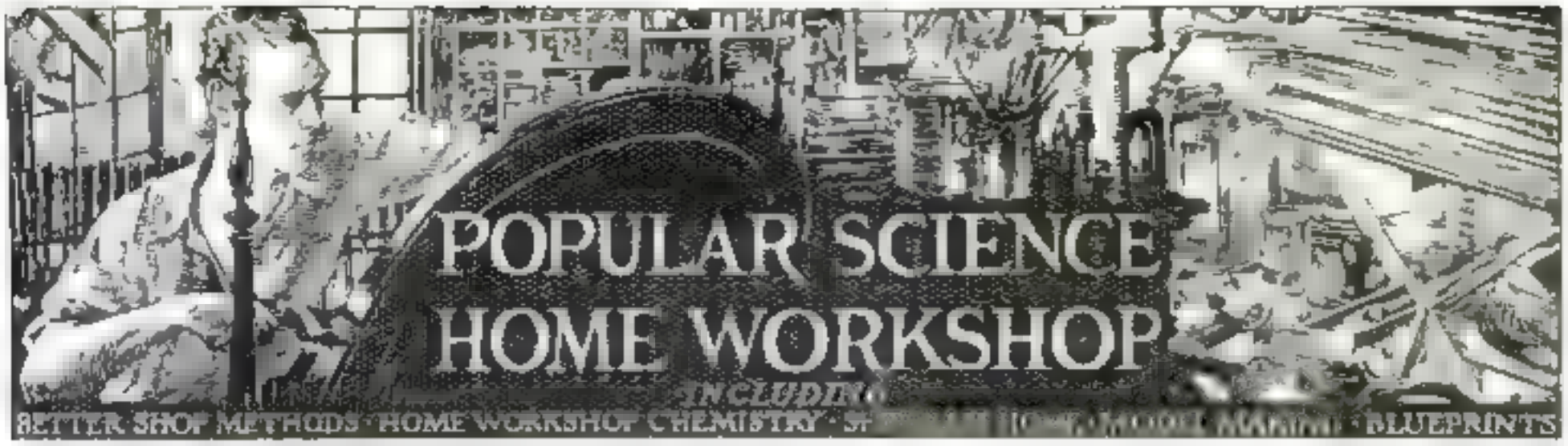
"I can do better than that," Gus offered. "Just say the word and I'll fit a petcock in place of the plug so you won't have to use a wrench at all."

"Sounds like a swell idea," said Madison enthusiastically. "I always wondered why they don't fit all cars with some way to get the oil out of the crankcase that isn't so much trouble as taking out a plug. I've had a lot of trouble with plugs. Twice dumbbells at service stations have chewed all the corners off the plug so I had to get a new one and once a bonehead stripped the threads so I had to have him plug the hole with a wooden plug so I could get to a service station. Cost me ten dollars that time!"

"Well," Gus explained, "a good bronze petcock costs more than a plug. Besides, the oil runs so *(Continued on page 151)*

GUS SAYS—

THE older a tire gets, the more likely it is to be neglected. And that's dead wrong, because the old tire is the one that needs babying along to make it go as many miles more as possible. Watch an old tire like a hawk. Keep it pumped to just the right pressure. Too much may make it pop like a firecracker and too little speeds the wear on the old and weakened shoe.



New Drive for Power Tools

Unique shaft mounting permits instant adjustment of belt tension to suit the load—Easily applied to any workbench

By FREDERICK D. RYDER, JR.

SLIPPING belts cause more trouble and delays than any other item in the motorized home workshop. Just when you have to rip a piece of tough hardwood, the circular saw ceases to bite because the belt starts to slip. Then, if the saw is driven by a pulley on a shaft that also drives other tools work is interrupted while a piece is cut out of the offending belt. The tightened belt will make the saw function as it should, but more delay may be encountered if the same piece of hardwood causes the jointer belt to slip.

The common solution, apparently, is to keep all the belts so tight that they will not slip on the toughest job. However extra tight belts mean lost power and excessive bearing wear on the light work that comprises nine tenths of the jobs in the home shop.

What is needed is a quick way to adjust any individual belt to just the proper tension for the job in hand—a system, in short, that will permit the belts to run relatively loose on the lightest work to save wear on the bearings and yet permit instant temporary adjustment to heavy tension for the occasional tough jobs.

I have found that a special mounting for the pulley shaft and motor satisfactorily meets these requirements. The various tools, consisting of a circular saw, lathe, jointer and jig saw

Fig. 1. The motor belt is adjusted by moving the motor platform vertically, a motion of 2 in. being possible

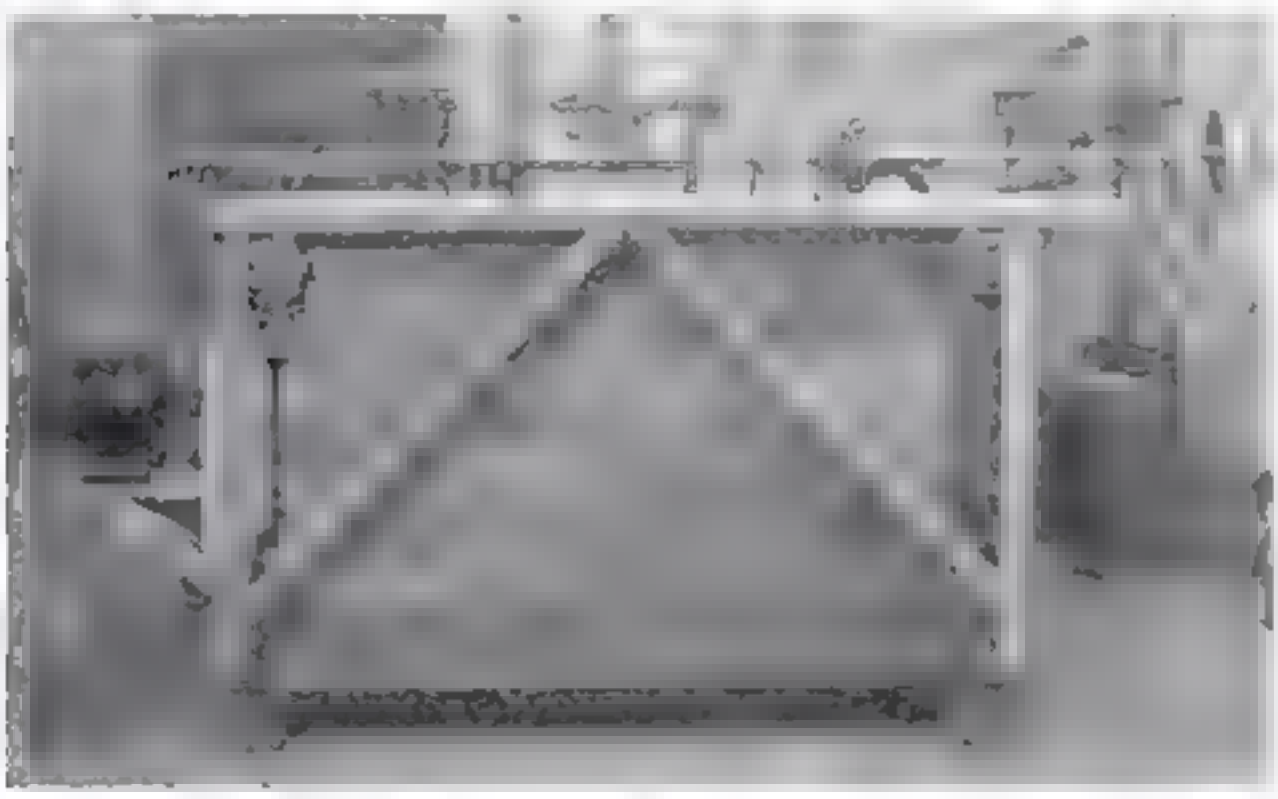


Fig. 2. The shafting and motor are mounted on a special framework hinged to the back of the bench. The frame can be swung back as much as 2 in. to adjust the tension on the belts.

are screwed to a bench 5 ft. long. The drive shaft runs in bearings bolted to a special swinging frame attached to the back of the bench by hinges at the bottoms of the vertical 2 by 4 in. pieces which form the ends of the frame. The motor is bolted to a platform that is clamped to one end of the swinging frame. The frame carrying the pulley shaft and the motor can be swung back from the bench a full 2 in., which with the double-drive, continuous, round-belt system I am using, gives an adjustment equivalent to taking a full 8 in. out of each belt. And when you have, by long and hard use, stretched a short belt 8 in., the belt will be worn out anyhow!

The motor is mounted on a platform attached to the frame that carries the pulley shaft, therefore swinging the frame to get the right tension on the belt driving any particular tool will not change the tension of the motor belt. The latter can be independently adjusted by moving the motor platform up or down on the vertical

Fig. 3. The swinging frame locked at the limit of rearward motion. This is equivalent to cutting 4 in. out of a single belt.

"two by four" that forms the end of the frame (Fig. 1). Here, too, a full 2-in. adjustment is provided.

A rear view of the whole outfit, showing the swinging frame with motor attached, is shown in Fig. 2 and the amount of adjustment permitted is indicated in Fig. 3 where the frame is moved back to the limit of motion. Figure 4 illustrates the motor end of the frame with the frame clamping block removed and the motor clamping block swung out of line so that the slots which permit movement are clearly shown.

THE dimensions given on the drawing (Fig. 5) are those of my own outfit. Of course, no two homemade workbenches are alike, so that the actual dimensions are given only as a guide to help you figure the lumber needed and to help you design a similar frame for your own bench. The diagonal pieces are put in to reenforce the frame and make it rigid, they should not be omitted. Except for the three clamping blocks and the motor platform, dressed 2 by 4 in. lumber is used throughout. This is actually about 1¾ by 3½ in.

As you will note from the illustrations, T-hinges are used with the wide part of the T screwed to the bench and the long end sawed off so that it can be screwed to the bottom of the upright end piece.

Assuming that your bench is flat at the back, the first job is to cut and fit the vertical end pieces to the hinges and screw the hinges in place on the bench. Then, with the vertical pieces clamped against the bench, fit the top section which carries the pulley shaft. It should be fastened at each end to the uprights by means of two 3½-in. No. 18 flathead steel wood screws. Of course, if you wish to go in for mortised joints, that is your privilege, but the large wood screws make a very firm joint and one that can be kept tight no matter how much the wood shrinks. After the top rail has been fitted, cut and fasten on the diagonal braces.

With the frame braced or clamped tightly against the back of the bench, the next job is to fit the locking blocks *A*, Fig. 5. These are 2 by 4 in. pieces placed endwise against the bench ½ in. below the top rail and then clamped to the uprights. The ½-in. space is necessary to allow the top rail to swing back without jamming against the tops of the locking blocks (see Figs. 2, 4 and 5).

While firmly clamped, the locking blocks should be bored with two ⅜-in. holes, one near each edge. Bore clear through the locking block and the bench behind it. Then two 4½-in. carriage bolts of suitable length are used to bolt each of the blocks to the back of your workbench. If your bench is so constructed that the locking blocks, because of an overhanging top, cannot be fitted this way, arrange to bolt them to the legs of the bench.

After the locking blocks have been fitted and while the frame still is braced or clamped against the back of the bench, run the ⅜-in. auger bit through the upright frame ends at a point where it will pass through the locking blocks a trifle above the center line between the bolts that hold them in place. Then swing the frame back 2 in. and clamp it at that point. Using the holes through the frame ends as guides, bore another hole in each locking block.

NEXT swing the frame out of the way and join the two holes in each locking block into a slot by boring a row of holes between them and chiseling out the remainder. Two clamping plates, which are squares of 1-in. wood, are used to cover the slot and give a better clamping action. These are bored with ⅜-in. holes and placed under the wing nuts on the ⅜-in. locking bolts. By means of these wing nuts, the frame can be clamped at any desired point within the 2-in. limit of motion. And it will be found that the framework, wherever it is set, is as rigid as though permanently fastened.

The motor platform will fit almost any standard ¼-horsepower motor of the squirrel-cage, split-phase starting type. After the 2 by 4 by 16 in. piece is cut, it should be clamped to the upright at the low position. Bore two holes with the ⅜-in. auger bit approximately in the positions indicated in Fig. 5. Then clamp the piece 2 in. farther up and run the auger bit through each hole again. With auger bit and chisel, form slots in the frame uprights just as was done in the case of the locking blocks. One of these slots is shown in Fig. 4.

Then finish the motor platform, being sure to place the lower ⅜-in. bolt in its hole before you add the diagonal bracing piece. This completes the job, and you can proceed to mount the shaft bearings and the motor.

Next month Mr. Ryder will present a solution of another problem in driving small power tools. He will show you how to end your troubles with belt hooks and belt lacings.

Fig. 4. The motor-platform locking plate swung out to show the slots that provide adjustment.

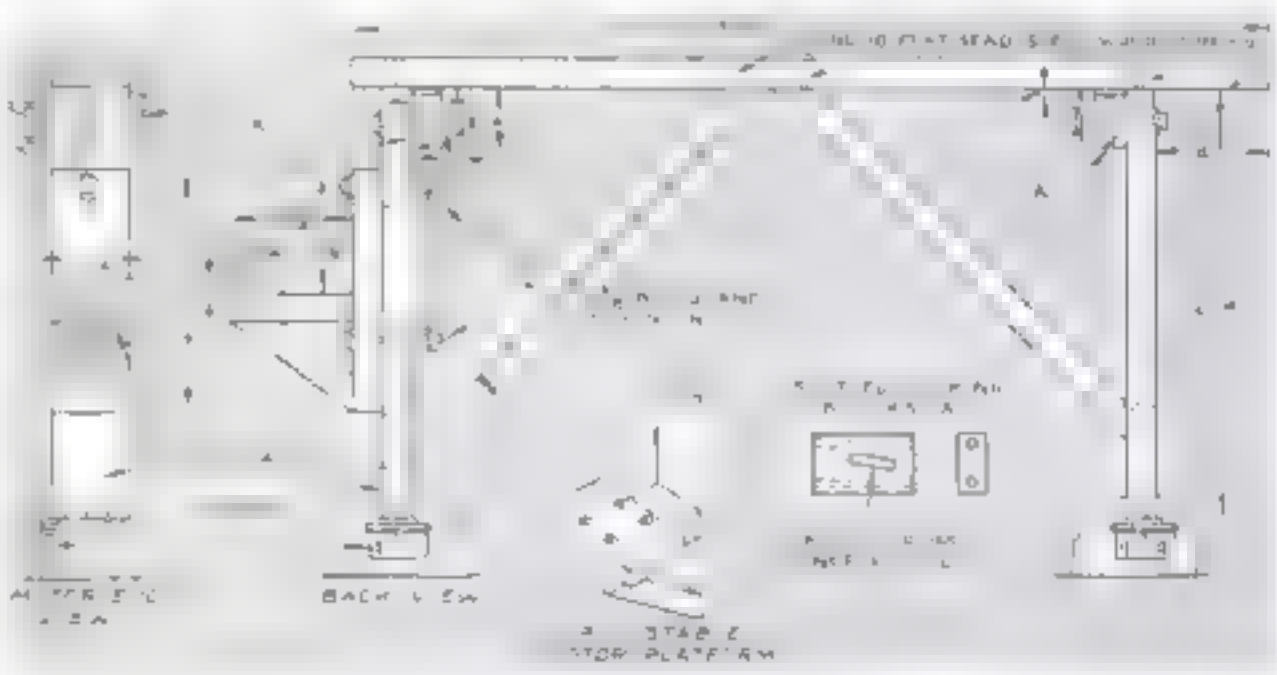
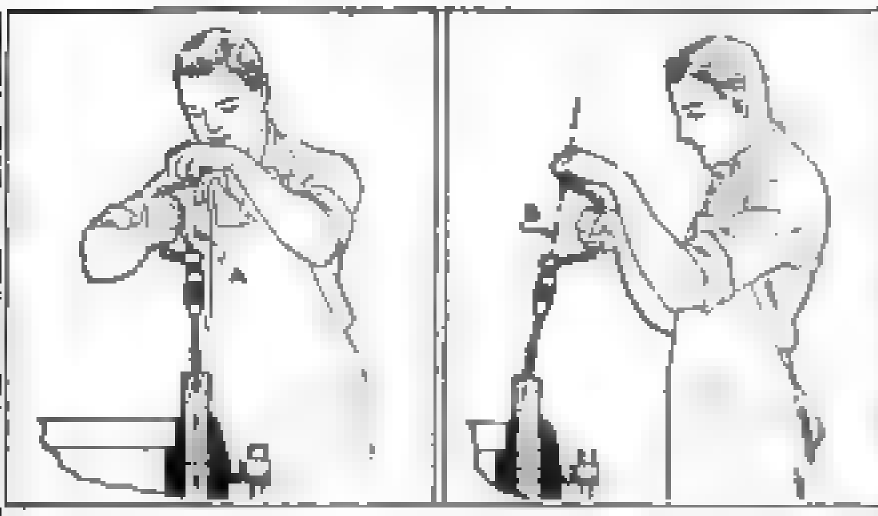


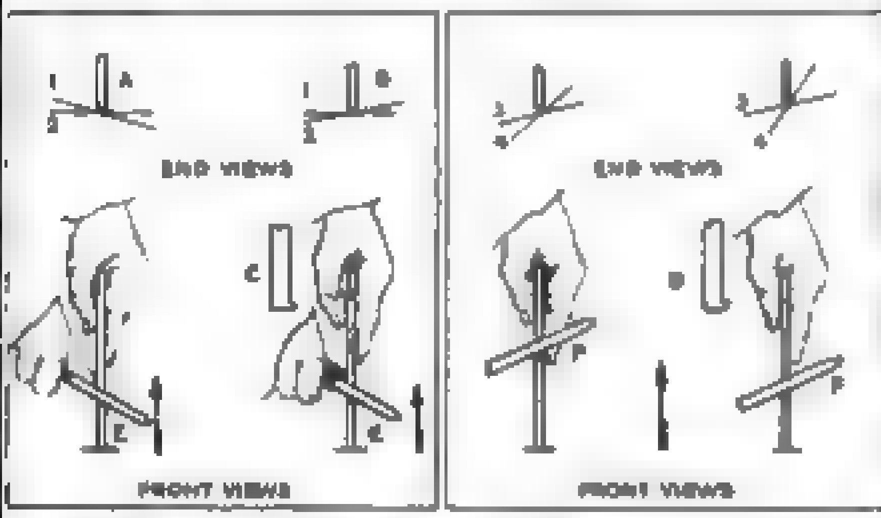
Fig. 5. The framework is made mainly of "two by fours." The dimensions should be altered to suit your bench. Two heavy screws are used at each joint. Be sure to drill pilot holes for them.

Woodworking Do's and Don'ts

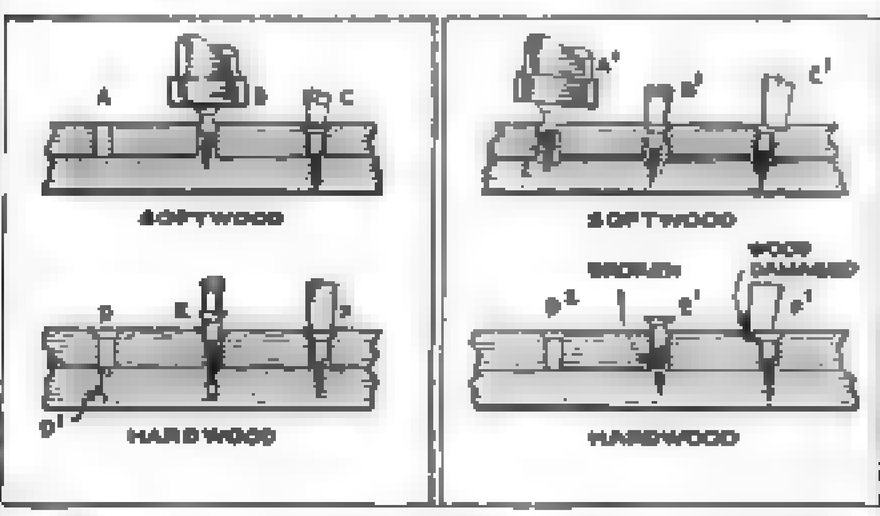
CHARLES A. KING gives tips worth remembering on bits, scrapers, slip stones, screws, and hammer handles



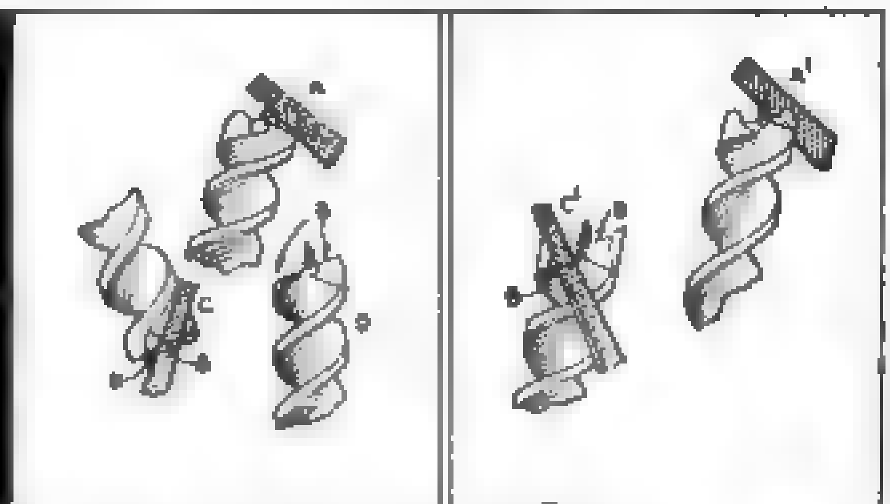
Few novices in woodworking [illegible] to bore straight holes. The sketch at the left shows the correct position in starting a hole. [illegible] of the bit exactly, and make a few turns with the vertical plane A passing through the bit, the axis of the bit brace, and the eye. Then, with the left hand held rigidly as a center, move around squarely in front of the vise and [illegible] right [illegible] This [illegible] prevents boring as at B



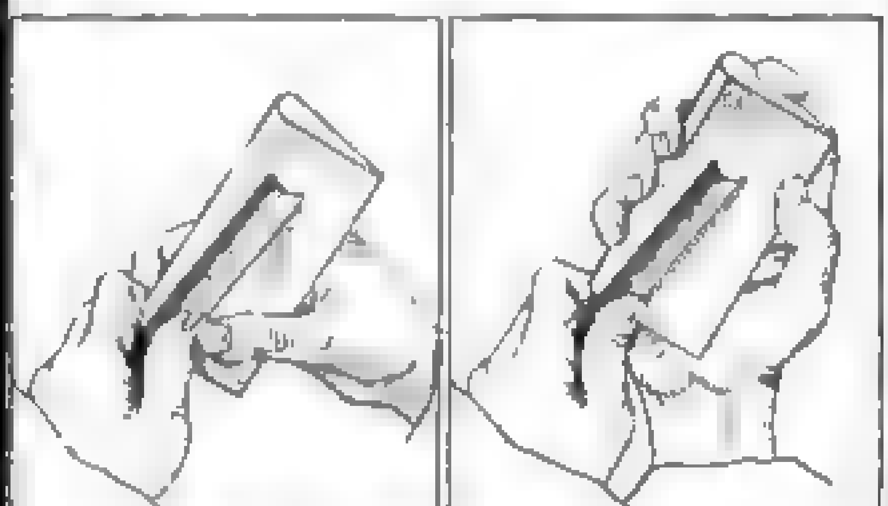
Scrapers with a beveled edge as [illegible] for floor and other coarse work. The square edge of B is [illegible] by cabinetmakers for fine work. After a scraper has been filed and [illegible] The keen corner should be turned over as at C, but not [illegible] as at D. Make one stroke with the burnisher held in position E and at [illegible] the angle [illegible] and another stroke [illegible] The right hand sketch shows the [illegible] and [illegible]



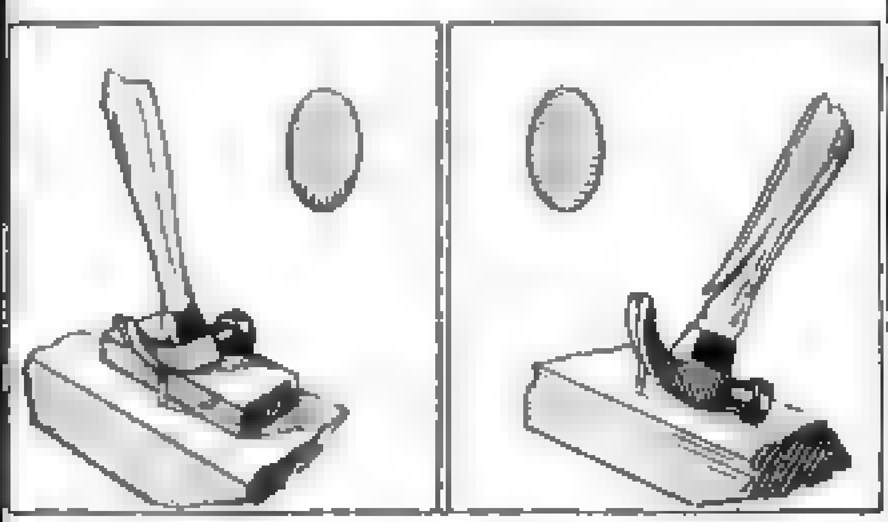
In driving screws in softwood bore a hole as at A, start the screw with a tap of the hammer as at B, and turn it home as at C. In hardwood bore a hole as at D, countersink it, and drill another hole somewhat larger than the core of the screw at D'. Apply soap to the point of the screw, enter it as at E, and drive it home with the screw driver held straight as at F. What may happen when no hole or only one hole is drilled is illustrated at the right



At the left is shown the correct method of sharpening auger bits. The spurs should be sharpened on the [illegible] and not as at A' of the right-hand sketch. The cutting lips B must be sharpened on the top as at [illegible] the cutting edge being kept as thin as possible. [illegible] should never be sharpened on the bottom as at C' in the sketch at the right. At D of the left sketch is a [illegible] on which [illegible] have been filed. This [illegible] and wood

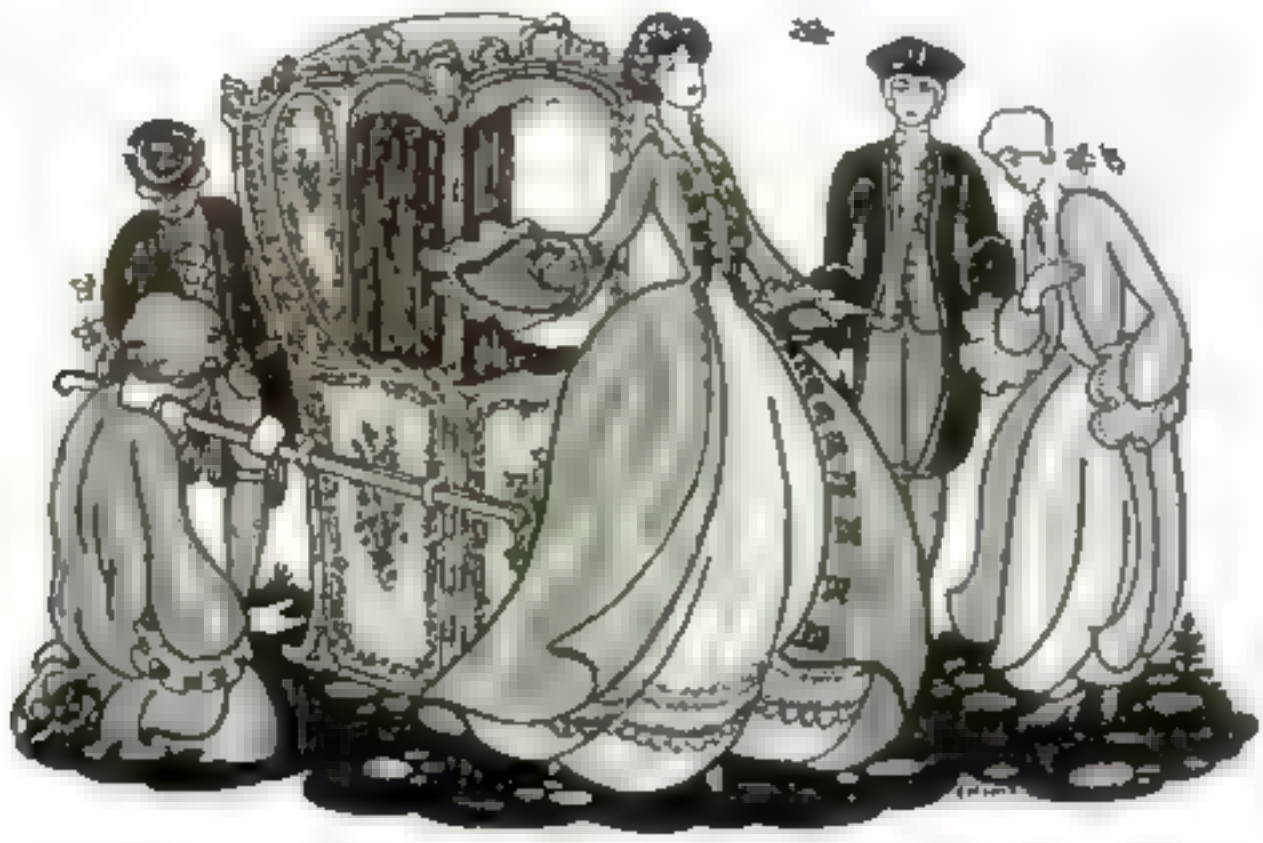


[illegible] in handling slip stones [illegible] cut. In no place [illegible] experience taught with more danger than in the use of the slip stone in sharpening [illegible] tools and gouges. The left sketch shows the method of [illegible] with the stone and the tool correctly [illegible] practically eliminates the danger [illegible] cutting the [illegible] which [illegible] is held as in the right hand sketch, where one [illegible] result in a [illegible] cut



The craftsman selects a hammer with a handle in which the grain texture is very close and hard, the annual rings extending in layers upon the sides and showing [illegible] upon the elliptical end of the handle as indicated in the left sketch. Also, he applies judgment in using the hammer. In drawing a large spike, for example, he will place a block of wood under the head of the hammer. The right sketch shows a handle picked at random and how it was broken

Adding Figures to Our Model of a Queen's Sedan Chair



A sedan chair suggests a world of old-time romance and beauty even when only a model.

By EDWIN M. LOVE

WHILE the model of Marie Leszczynska's sedan chair described in a preceding article (P.S.M., Sept. '30, p. 73) is beautiful enough in its own right to make an attractive ornament for the home, yet its interest is increased manyfold if the figure of a dainty lady is placed inside and if the sedan is hung from the capable hands of a pair of strapping chairmen in miniature.

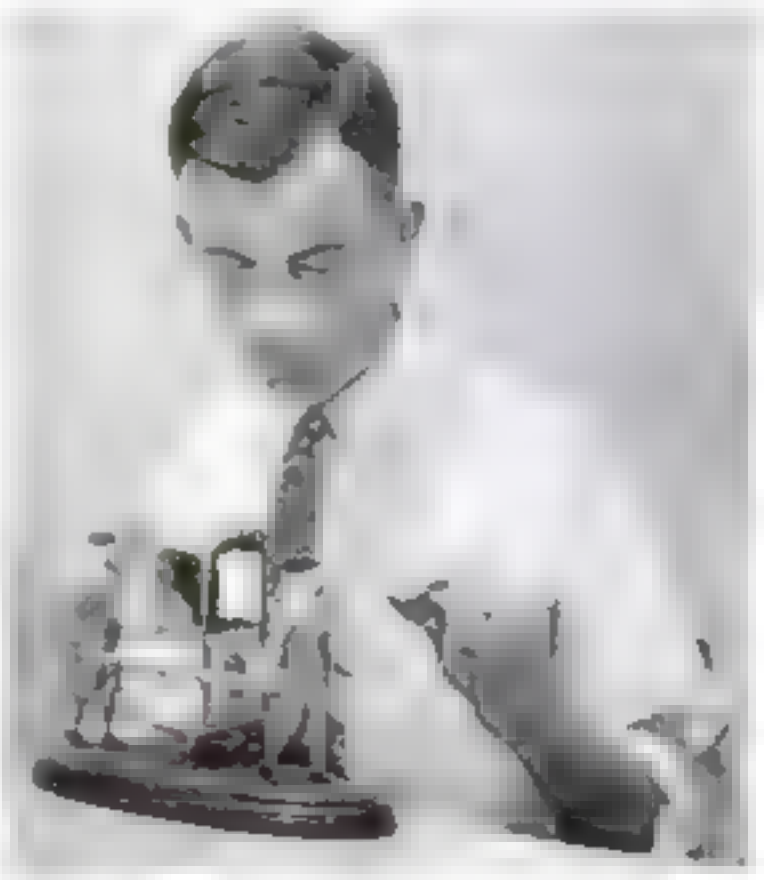
Such figures are not difficult to make. No great care need be taken with anatomical detail since the clothes will hide a multitude of faults. The work will be found considerably easier, however, if POPULAR SCIENCE MONTHLY Blueprint No. 124 is obtained (see page 113), because it contains full size drawings of the figures as well as patterns for the costumes and a full size detail of the base. This blueprint is a companion sheet to No. 123, which gives complete full size drawings for the sedan chair itself.

To make the figures and base, the following materials should be obtained:

For base, hardwood ¾ by 5½ by 12 in. and dull green linoleum, ⅛ by 5 by 11 in.; for chairmen, scraps of soft white pine; a few brads 1¼, ¾, and ½ in. long; Nos. ½, 0, and split 6-0 sandpaper; and a tube of household cement or glue. For decorating, four-hour enamels—black, red, white, and yellow. For chairmen's suits, medium-blue satin, 8 by 9 in., or equivalent; for coats, dark lilac or purple satin, 8 by 9 in.; for lining, the same quantity of orange-red silk; for trimming, 4 ft. of gilt braid, 1 yd. of ¾-in. lace edging, 1 ft. white baby ribbon; for hats, flannel 1¼ by 5 in., for shoes, leather 1½ by 5 in. (or old purse or kid glove). For queen, a porcelain figure. For queen's dress, pink taffeta 4 by 9 in.; for coat, light-blue silk 4 by 10 in.; for roses, 1 yd. pink baby ribbon, for wigs, small wads of cotton, also thread to match cloth.

CHAIRMEN. From white pine or other softwood, cut pieces for heads, trunks, arms, and legs. Trace the front and side profiles from Blueprint No. 124, transfer them to the blocks with carbon paper, and carve.

Trunks: If a power scroll saw is available, cut out the front tracings with it and the cut will automatically be square with the pattern, but if power equipment is not at hand, the sawing can be done well enough by hand. Temporarily nail back the waste sidepieces with two brads in each, and saw the profiles. With these pieces removed, most of the shaping is done, leaving only the corners to be rounded. However, the lower curves of the breast muscles, and the rib arches should be outlined with a veining gouge (or pocketknife). The breast muscles form a thick flat layer that projects somewhat at each side, forming a sort of receptacle into which the arms fit. Give a little relief to the vertical abdominal muscles.



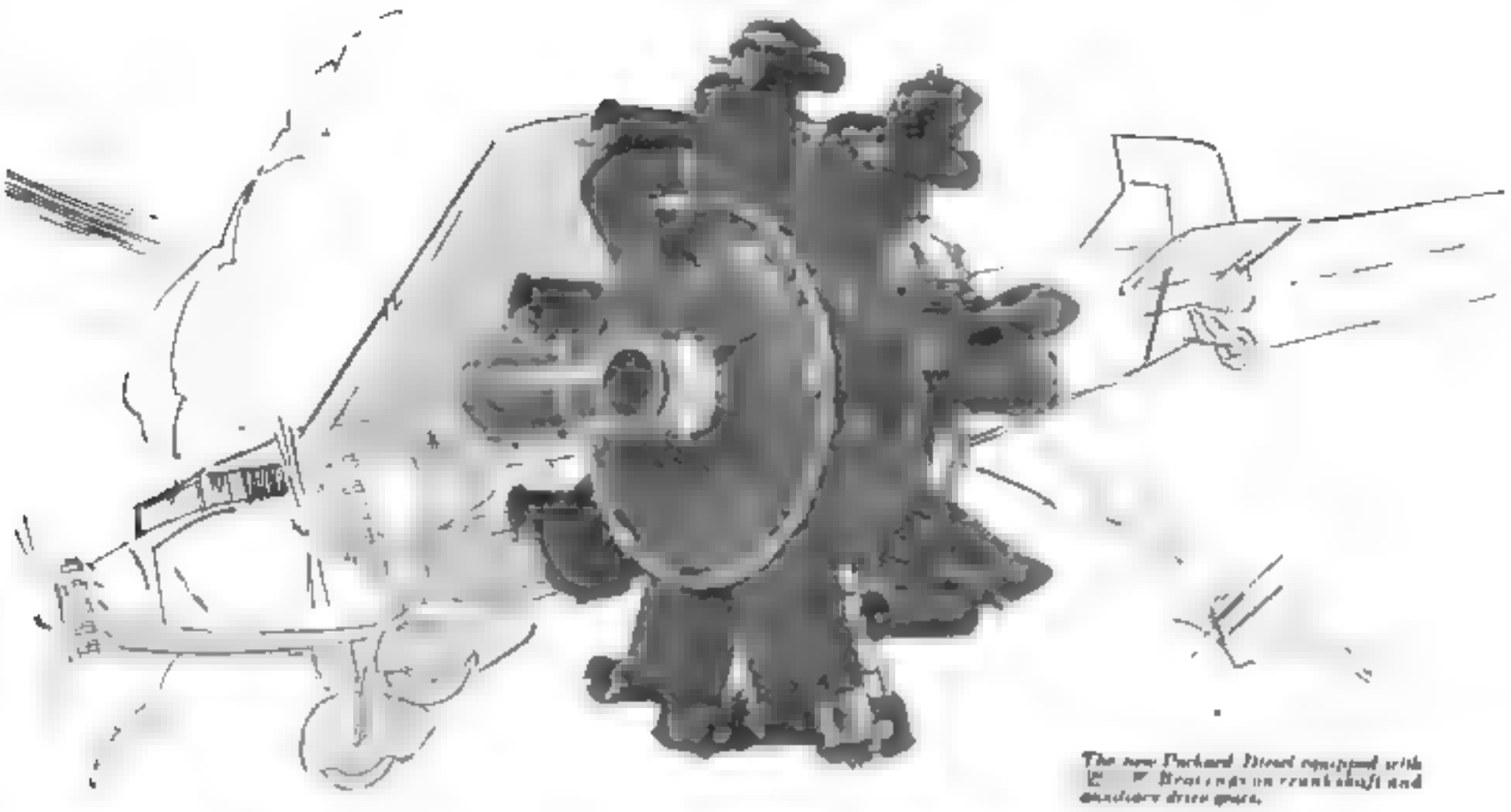
The colorful little sedan chair model with the queen inside. Mr. Love is tying the poles to the wrists of the men.

For those who prefer to model the figures rather than cut and carve them out, an alternative method of construction is to shape the parts from a prepared wood putty which is plastic when taken from the can but hardens to a substance like grainless wood. When hard, it can be further shaped with a pocketknife.

Legs: Saw out like the trunks and round to the sections shown. If the toes break off, it matters little.

Arms: The upper arms are oval in section from front to back, as are also the wrists, while the forearms near the elbows are oval from side to side.

Head: The head is oval from any position, and egg shaped when viewed from either front or back. After rounding the corners, hollow the eyes and round the cheeks. The eyes are sliced in and down with oblique strokes, and the line of the chin is hollowed beneath, fading toward the ears.



The new Packard Diesel equipped with SKF Bearings on crankshaft and auxiliary drive gears.

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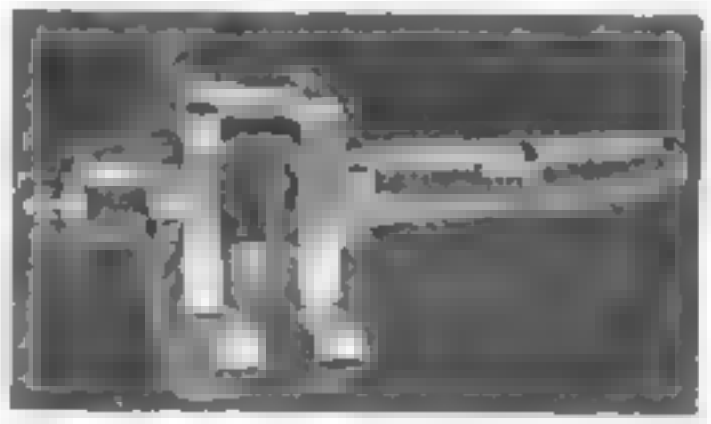

The single throw crankshaft of the new Packard Diesel. Note the two SKF Cylindrical Bearings mounted alongside of counterweight.

The third SKF Bearing supports forward end of crankshaft and takes propeller thrust.

If you have a bearing problem, whether it's in the air, on the land, or on the sea, our engineering department will gladly help you solve it. SKF Industries, Inc., 40 East 34th Street, New York, N.Y.

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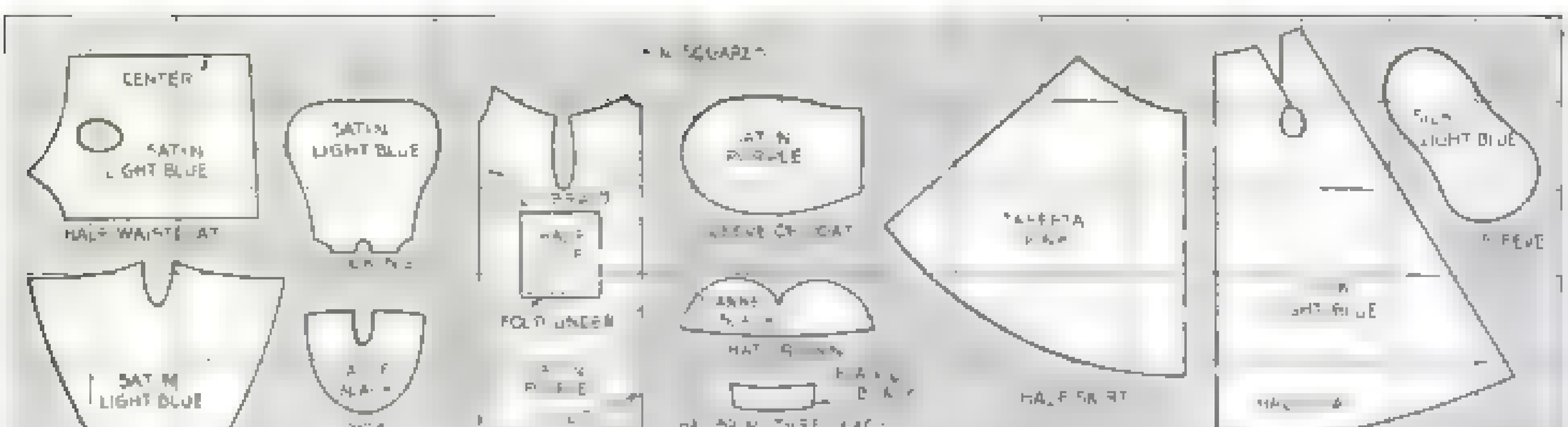


How to cut the cloth for the costumes. Note that only half of some of the pieces is shown and that the pattern for half the cuff is drawn as if laid in its proper position on the chairman's coat.

Assembly: Glue and nail the members to the body The feet should toe out, but not too much. Trim the upper ends of the thighs and the joint-parts of the trunks to get the proper attitudes. Carve to smoothness, building up false depressions with a wood composition The upper arms, viewed from the sides, hang nearly vertical, with the forearms inclined slightly forward.

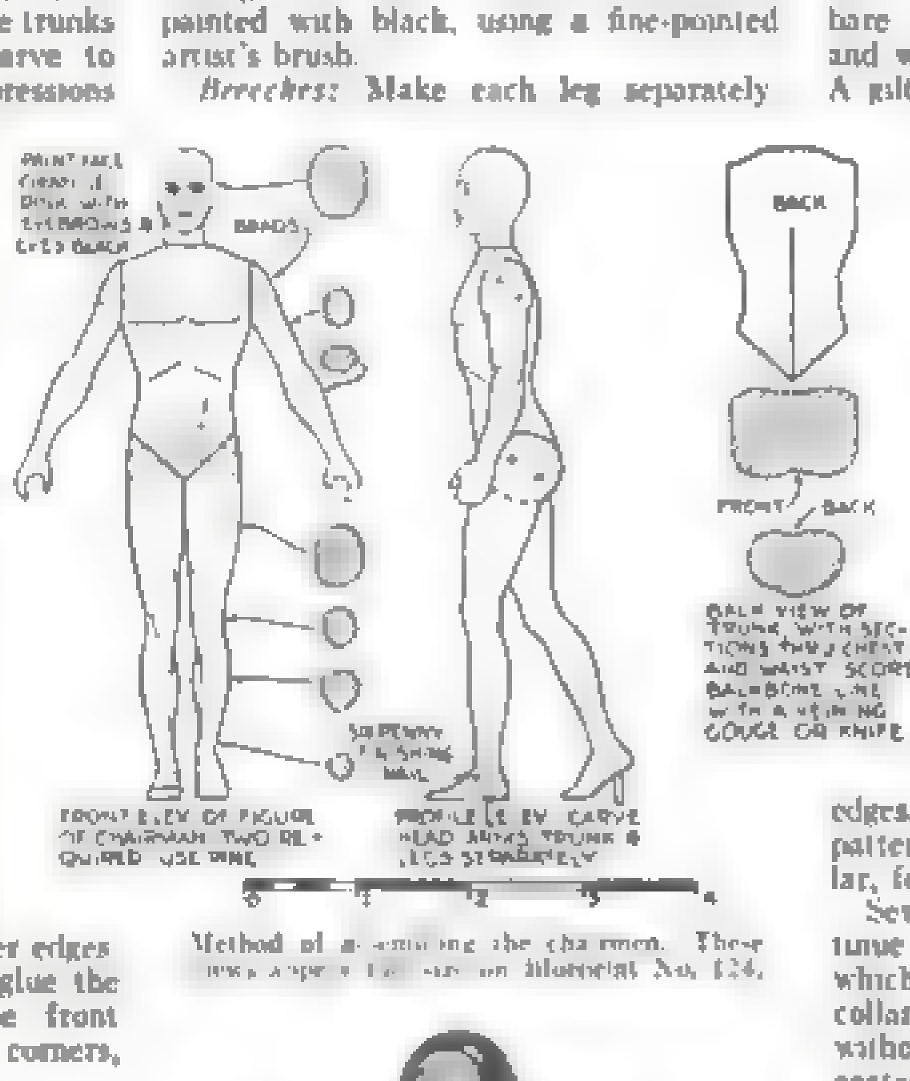
Supports: Drill the feet and ankles to receive sixpenny finishing nails whose projections fit into holes in the base

QUEEN: Purchase a porcelain figure at a five-and-ten-cent store—one without legs, so that it can be seated in the chair The head should be about 11/16 in. high, with the hair modeled close; bobbed hair is best. The writer chose a figure pressing roses to her bosom, but any graceful attitude of the arms will do, provided the gesture is reasonable in the seated figure.

DRESSING THE CHAIRMEN *Waistcoats.* Cut these in two parts and run a band of household cement around the outer edges inside. Slip them in place, and glue the backs and shoulders. Glue the front edges overlapping near the lower corners, as in Blueprint No. 124.

For buttons, rip a strip of hardwood 1/16 in. square, round with sandpaper, and cut off slices with a sharp chisel. Glue these to the right edges of the waistcoats, 1/8 in apart, except where the other sides are buttoned over; there put three buttons on each as though they came through buttonholes. The buttonholes are painted with black, using a fine-pointed artist's brush.

Breeches: Make each leg separately and draw it tightly around the thighs either sewing over and over, with the seam at the outside, or using cement If bare wood shows between the breeches and waistcoat, glue in a triangular piece. A gilt band encircles each leg below the knee. The stocking seams are at the back.



Method of assembling the chairmen. These views appear full size on Blueprint No. 124.

Shoes: Cut from a thin purse or a kid glove. Glue around the feet and bind with twine until dry. Then trim, glue on cardboard heels, and color black with India ink

Cravat and Shirt: Wrap a band of white satin around each neck, gluing the ends outspread to form the small bit of shirt exposed

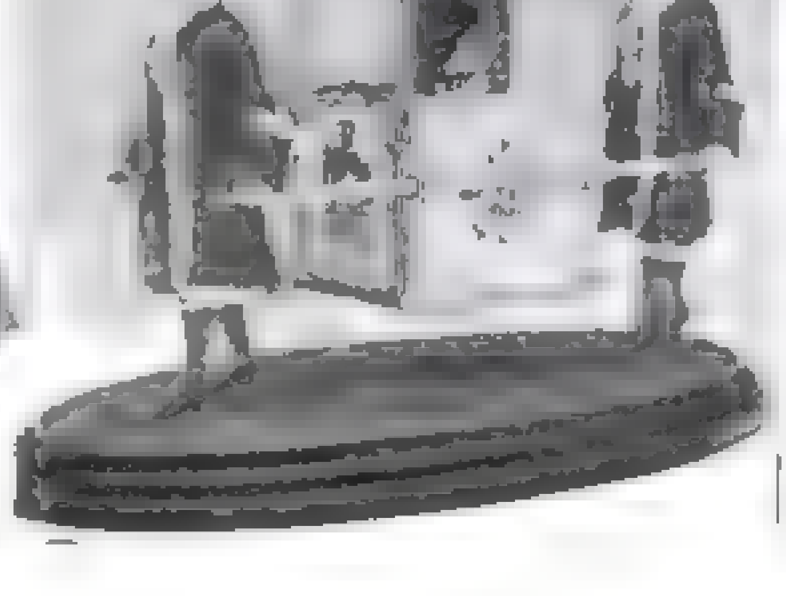
Coats: Cut each in one piece, gluing at the edges a lining of orange-pink silk. Split up the back for 1/4 in. Fold a length of 3/16-in. gilt braid lengthwise along the center and glue it around the outer and lower edges, as shown by the dotted lines in the pattern. Leave the ends loose at the collar, for adjustment after fitting

Sew or glue the coats in place, and continue the gilt bindings around the necks, which lie flat instead of standing up like collars. Any widths of braid can be cut without fraying if the inner face is first coated with glue. Gather the coats under the arms a little.

Cuffs: These are bound with gilt braid along the tops and at the backs where the ends come together

Shirt Ruffles: Glue three lengths of

At left: How the chairmen appear from the base. The top of the base is [illegible] *(above)* [illegible] figure of the queen. *At right:* Finished model.



"RCA Radiotrons bring out the full tone beauty"

says

E. F. McDONALD, Jr.

President

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RCA Radiotrons

⅜-in. edging lace in the upper opening of each waistcoat, gathering them.

Hair: Glue a small wad of cotton to each head. Pat it down thin, roll it up over the ears, and gather it into a short queue by tying with thread.

Hats: Sew the crowns together, gluing the three side rims to each, with one corner in front and the other two at the sides. Color black with India ink. When dry, brad and glue the hats to the heads. Adjust the rims to flare outward.

QUEEN'S COSTUME. *Skirt.* Cut from pink taffeta ribbon and glue to the doll around the waist. When dry, trim the upper edge with a razor blade to fit the arms.

Bodice: Glue pink taffeta, in two halves, to the body, tucking around the sides and trimming around the hands. With black paint draw two cross laces directly above the roses.

Coat: Edge with glue to prevent fraying, and glue to the figure. Gather the back at the waist with a draw thread. Trim to hands and arms. Glue on the sleeves. Notice that the large flaring cuffs are edged with ⅜-in. lace, and a ⅛-in. strip cut from the same material forms a collar on the coat and also edges the bodice above the lacing. For the roses, twist pink baby ribbon and roll into small blossoms. Glue tiny medium-green silk leaves around the roses.

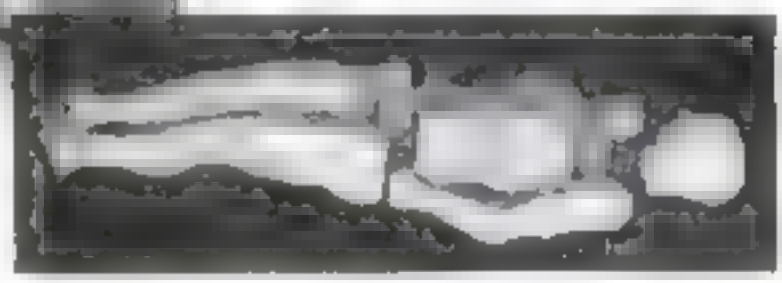
Hair: Cover the porcelain hair with cotton.

BASE: Trace the shape on hardwood (the oval is 5½ by 12 in.) and saw it out. Gage for the rabbet and carve the molding. Shape the linoleum, trim off the back until the thickness is ½ in., and outline the stones with a veining gouge. Glue the linoleum to the wood and drive brads in the edges at the joints between the stones. Set the nails and fill the holes with bits of linoleum. Paint the exposed wood black, three coats, rubbing the first and second with split 6/0 sandpaper, and the last with pumice stone and water.

MOUNTING: Drill holes in the base to receive the nails in the feet of the chairmen, insert the poles in the chair, and tie the ends to the hands of the men with several wraps of white thread passed around the wrists and back of the fingers around the grips. The chair need not be exactly vertical, in fact, a little cant will give action to the model.

Seat the queen inside, tucking her skirts down behind the door in a manner to suggest knees beneath.

Above: Sawing a leg profile for one of the figures. Note that the front shape has been sawed, the waste pieces having been tacked temporarily back in place. *At right:* The parts after being sawed out and ready to be carved.



Another article scheduled for early publication will describe stagecoach and covered wagon weather vanes.

How to Turn Totem-Pole Candlesticks

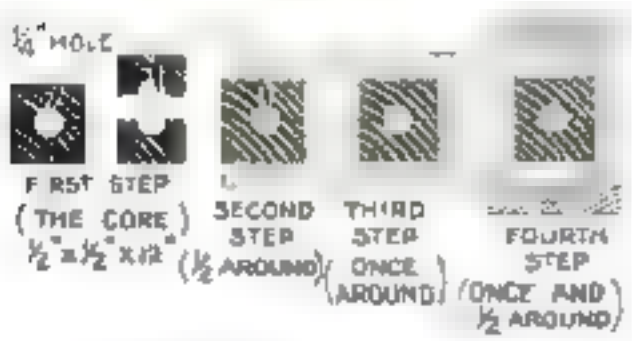
By H. CALDWELL

SOMETHING different from ordinary designs and quite simple to make are the electric totem-pole candlesticks illustrated. The Indian-like patterns are obtained by the use of woods of various colors.

In most variegated wood designs, the work is built up in layers, but in this method the wood is placed around a core, all four sides being covered. Care must be exercised in building up the stock, and a good glue is imperative. While ordinary hot glue may be used, a waterproof glue is preferable on account of its moisture- and heat-resisting qualities.

A core of black walnut ½ in. square and 12 in. long is planed true, and a ¼-in. hole is bored through its center. If a drill 6 in. long is not available, the core may be made in two halves and a groove cut in each with a gouge. The halves are then glued together. In either case the holes are plugged with soft wood for the turning operation.

Around this core is glued a $\frac{3}{16}$ in. thick layer of sycamore or other white or light colored wood. Opposite sides are glued first and held with C-clamps while drying. When dry, these are trued up with the plane, and the other sides are glued on. Plenty of glue should be used, and the clamps must be securely fastened or there will be uneven contact and when the pieces are turned gaps will show between the different woods. A piece of hardwood about 13 in. long should be used to protect the wood from the clamp marks. The sycamore is followed by a layer of African padouk (red), and finally a round of satinwood (yellow). Other woods, of course, can be used provided they are sufficiently colorful.



How the stock for the upright members is built up from three woods of contrasting colors.

After thoroughly drying, the blanks are turned in the usual manner. Those not expert in turning may hesitate to undertake the job for fear of spoiling the built-up stock. If so, it will cost little to have them turned by a professional turner.

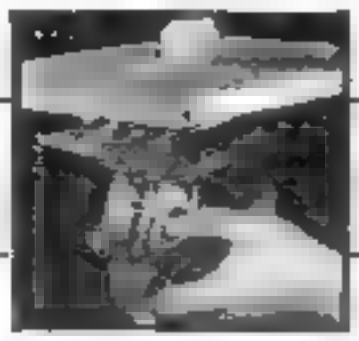
The stock for the base is made 6 in. square of ½ in. thick black walnut and $\frac{3}{16}$ in. thick layers of satinwood, padouk, and sycamore. A side hole for the electric wire may be bored in the base after it is turned. A brass bushing is inserted in the end of the candlestick, and the socket and other electrical fittings are added. The design for the turning, which was taken from the *Home Workshop Manual*, lends itself well to this style of work.

It is better to finish the candlesticks before assembling, as the work can be done so easily in the lathe. A coat of equal parts of raw oil and turpentine is first applied to bring out the colors of the wood. This is allowed to dry overnight. Then three coats of white shellac, with a sanding between each coat, are followed by two coats of rubbing varnish or lacquer. The first varnish coat is sanded and the final one is felt-rubbed with pumice and water. Finally, a coat of wax is applied and polished, and the result is a very rich luster.

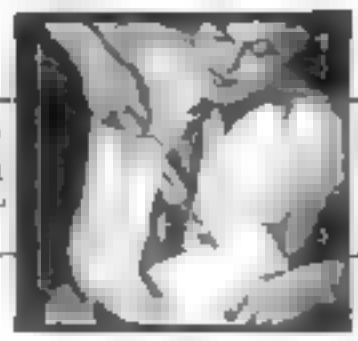
Various combinations of woods may be used. A good thickness is $\frac{3}{16}$ in. because it builds up rapidly, although ¼ in. would give a more variegated effect. Dealers in fret or inlay woods always have a stock of suitable woods.

MAKE THESE TESTS

BUILD A INCH THICK WALL MEANS
12½% MORE EFFICIENT INSULATION
THAN ORDINARY ½ INCH LATH AND PLASTER BOARD



INSULITE



STRENGTH TESTS OF FOUR WELL KNOWN INSULATING BOARDS
14% PROVE INSULITE STRONGER

Place a cube of ice on a piece of Insulite over an automatic electric iron set at hot. See how long it takes the heat to penetrate the Insulite and melt the ice. Make the same test with other insulating boards—the result shows the greater efficiency of Insulite.

Drive a nail a half inch in from the edge and through a board of Insulite. Loop a string tied around the nail and with hand scales see how much greater pull is required to tear the nail through Insulite than through other insulating boards.

After all – QUALITY TELLS THE FACTS

That's why – INSULITE SALES CONSTANTLY INCREASE
– We urge you to send for FREE SAMPLE and test it yourself.

THERE are lots of good insulation boards on the market. Insulation in your home means big returns in fuel savings — a warmer home in winter — as well as a cooler home in summer.

Certain discriminating people, however, want more than just a good Insulation board — they want to know *which is the best*.

It's to these people that this advertisement is addressed.

First of all — Insulite is a board form insulation material in broad rigid panels 4 feet wide and in various lengths up to 12 feet. It is easy to apply, and because it may be used as sheathing in place of lumber, or as plaster base in place of wood lath, it is not an expensive extra

Furthermore, as sheathing Insulite has several times the bracing strength of lumber horizontally applied, and as plaster base, it grips plaster twice as tightly as wood lath — this means freedom from unsightly plaster cracks.

You know the enduring qualities of wood. Insulite is made from the strong tough fibers of northern woods, chemically treated to resist moisture, rot, vermin, or rodents. It is not subject to disintegration. And made a full 1/2 inch thick, Insulite gives 12½% *more efficient insulation* than ordinary 7/16 inch thick insulation boards.

You want your home strong. A recent test of four well known insulation boards shows *Insulite to have 14% greater strength* — (we will gladly send you an Insulite sample with which to make the above pictured tests.)

Insulite has many other advantages—It is an efficient sound deadener — but, let us send you our booklet on "Increasing Home Enjoyment". It tells how easily Insulite may be used to line your attic, basement, build extra rooms, closets, garages and other buildings. Send the coupon now — test Insulite yourself — then we know you will specify Insulite when you order from your lumber dealer.

SEND FOR SAMPLE AND FREE BOOK

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(A Backus-Brooks Industry)
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OFFICES IN ALL PRINCIPAL CITIES

Please send me a sample of Insulite and full information how to make the tests pictured above— also a copy of your free book, "Increasing Home Enjoyment."

Name

Address

City State

INSULITE

the Wood-Fiber Insulating Board

Useful Hints for Car Machinists

How to Use Tire Pump to Fill Vacuum Tank —Siphon in Lye Solution to Clean Radiator

PROVIDED the filler cap on the gasoline tank can be screwed down tight enough to prevent much air getting by the threaded portion, Fig. 1 shows a good way to fill the vacuum tank after the car has run out of gasoline. There is always a tiny hole in the cap. By placing the end of the tire pump over this hole and operating the pump plunger several times as rapidly as possible sufficient gasoline usually can be forced into the vacuum tank to start the engine

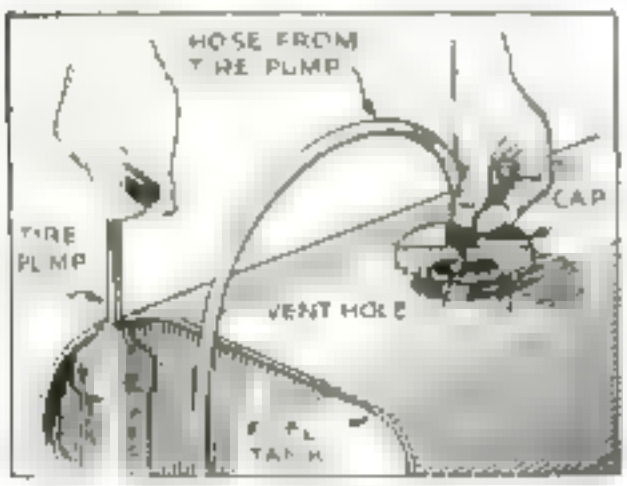


Fig. 1. Raising the air pressure in fuel tank will force gasoline into empty vacuum tank

SOLDERLESS TANK REPAIR

AN INGENIOUS way to repair a hole in a gasoline tank is shown in Fig. 2. If a hole develops on a flat surface, it can be enlarged to the size of a small screw. Then a disk is cut from the end of a cork and a hole made in it just large enough for the screw, with a washer under the head, to be forced through. With the aid of a wire clip, the screw is passed through the filler hole in the tank and set into the hole. Then a nut is screwed on. The pressure on the cork will make it gas-tight around the screw and against the inner surface of the tank.

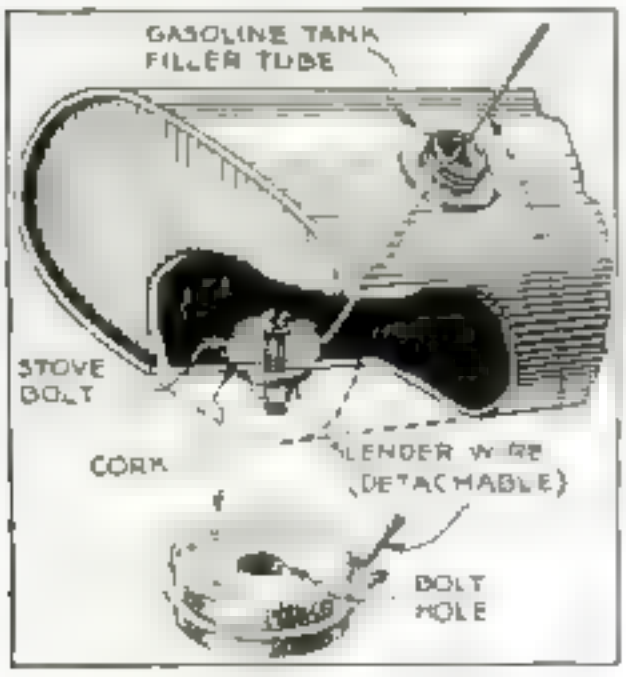


Fig. 2. A cork, a screw, and a washer can be successfully used to repair hole in gas tank.

Fig. 3. Put on a rubber mat under the step plate will save the mudguard from scratches.

MUDGUARD SCRATCHES

CLIMBING into the rumble seat of the roadster is easy enough by way of the step plates provided, but the heel often scratches the mudguard enamel around the plate. Remove the step plates on the mudguard, then replace it with a piece of rubber matting under it as shown in Fig. 3.

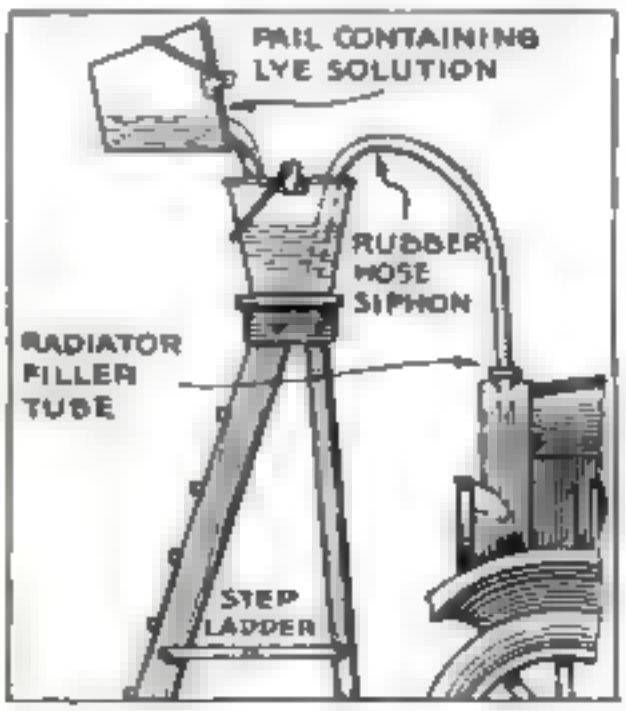


Fig. 4. To save car finish from lye solution start siphon with water and then pour lye in.

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to Walter E. Wikdahl, Brockton, Mass. (Fig. 4). Contributions are requested from auto mechanics.

LYE IN RADIATOR

A SOLUTION of lye is fine for cleaning radiators but it is bad medicine for auto finish. If you want to get the solution in the radiator without spilling any over the car finish, use method shown in Fig. 4

SIMPLE DOOR STOP

STICKS of wood and a couple of hinges make up the novel and simple door stops shown in Fig. 5. As the drawing shows, two sticks are driven into the ground for

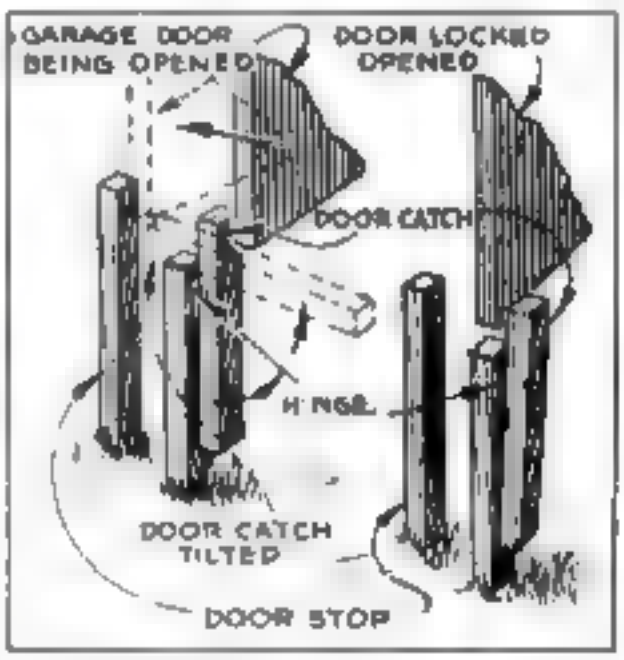


Fig. 5. Hinged sticks set at side of garage door, as shown above, will make a simple door stop.

each door one a trifle more than the thickness of a stick lower than the edge of the door and the other to act as a stop. Then sticks are hinged to the uprights.

GET RID OF POUNDING

TOOL marks on the braking surface of the drum may cause a pounding noise. The remedy is to polish out the tool marks as shown in Fig. 6, below.

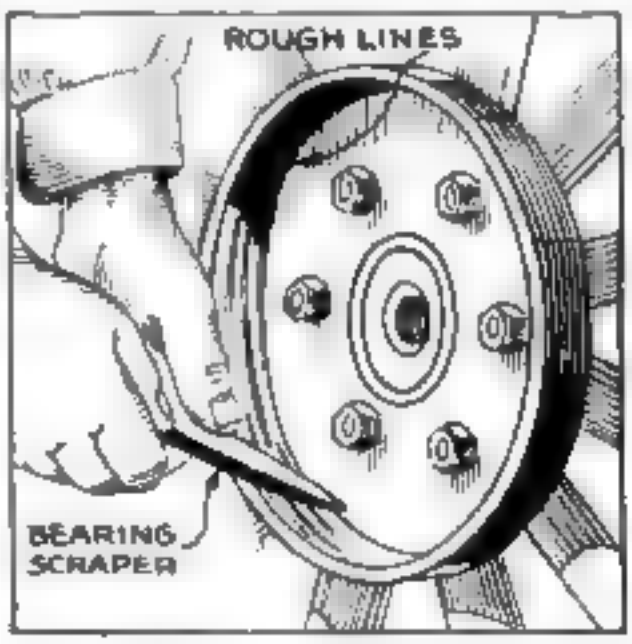


Fig. 6. Tool's marks on braking surface of drum cause pounding. Polishing ends it.

Drive this car five days *to prove your purchase!*

If it does not come up to your expectations, return it. This is the way the Studebaker pledge protects your ***investment.***

Pledge to the Public on Used Car Sales

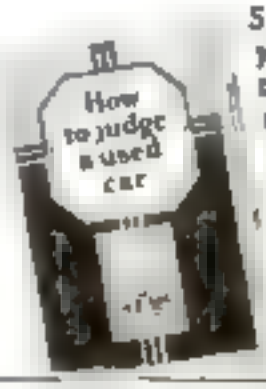
1
2
3

UNDER the terms of the famous Studebaker Pledge, you may drive the used car you buy *five days* before you decide. If it does not please you, you may return the car and apply your payment on any car in your Studebaker dealer's stock, new or used. This is *one* of the provisions which has made the Studebaker Pledge famous as the fairest, squarest used car sales policy in the industry.

More than 150,000 thrifty motorists bought Pledge-backed used cars last year. They got good appearance, good performance, and good value with the cars they bought. You will, too, if you buy a Pledge-backed used car. And you'll get a 30-day guarantee on Certified cars—plus plainly marked prices on all cars sold on this plan.

See your Studebaker dealer *first*—get Studebaker Pledge protection when you buy *your* used car—your greatest assurance of complete satisfaction.

INVEST 2c . . . . YOU MAY SAVE $200



Spend 2c now for your copy of this interesting and instructive booklet, "How to Judge a Used Car"—it may save you as much as $200 on the used car you buy. Mail the coupon now!

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STUDEBAKER

Builder of Champions

Complete Shop Built in One-Car Garage

[illegible] one-car garage

THAT s[illegible] not prevent one [illegible] having a well-equipped home workshop is illustrated graphically by the accompanying photographs of the shop of Holt Candon, a reader of POPULAR SCIENCE MONTHLY, in Pasadena, Cal. Only one side of the shop is shown, the other side is given over to a carpenter's bench and tools, a jig saw, and garden

The workbench proper is 15 in. wide, 3 ft. high and 8 ft. 6 in. long. On it is a line shaft running in ball bearings and driven by a [illegible] motor through a flexible coupling. This provides power for bench grinders, scratch brush, and buffs. A heavy piece of plate glass bedded in cork

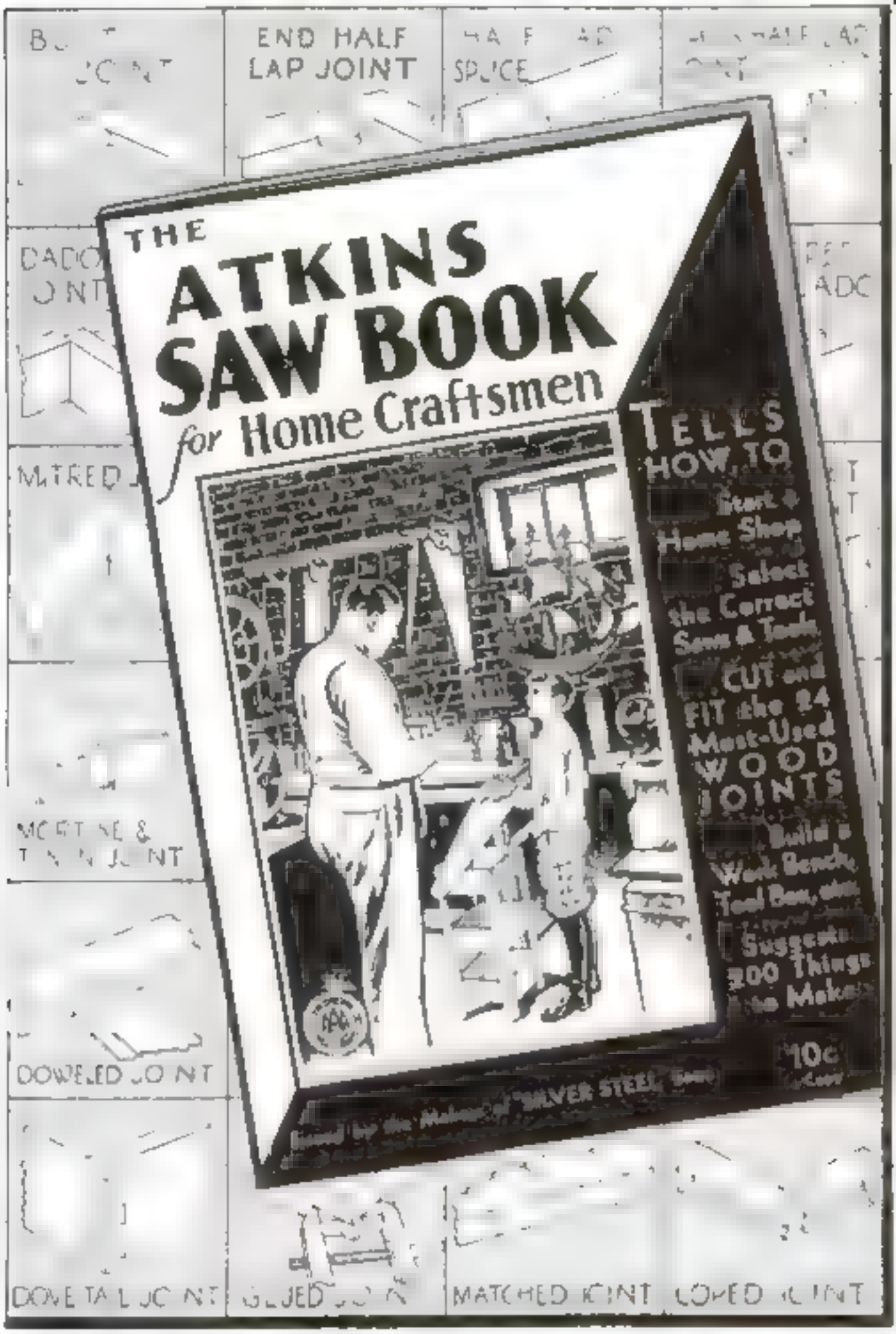
and a [illegible] cabinet.

At the right, on a lower stage of the bench is a 9-in. screw-cutting lathe. With its countershaft, four-jaw independent chuck, drill chuck, and tool holder, the lathe represents an original investment of something under two hundred dollars. Homemade tools and fixtures have greatly expanded its usefulness.

An Ingenious Way to Use a Hack Saw Blade

How the hack saw [illegible] to saw away the panel just below the hand molding.

24 JOINTS



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Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See Page 8.

Decorative as a painting, yet useful as a cabinet

This Sewing Screen Is a Gift to Please Any Woman

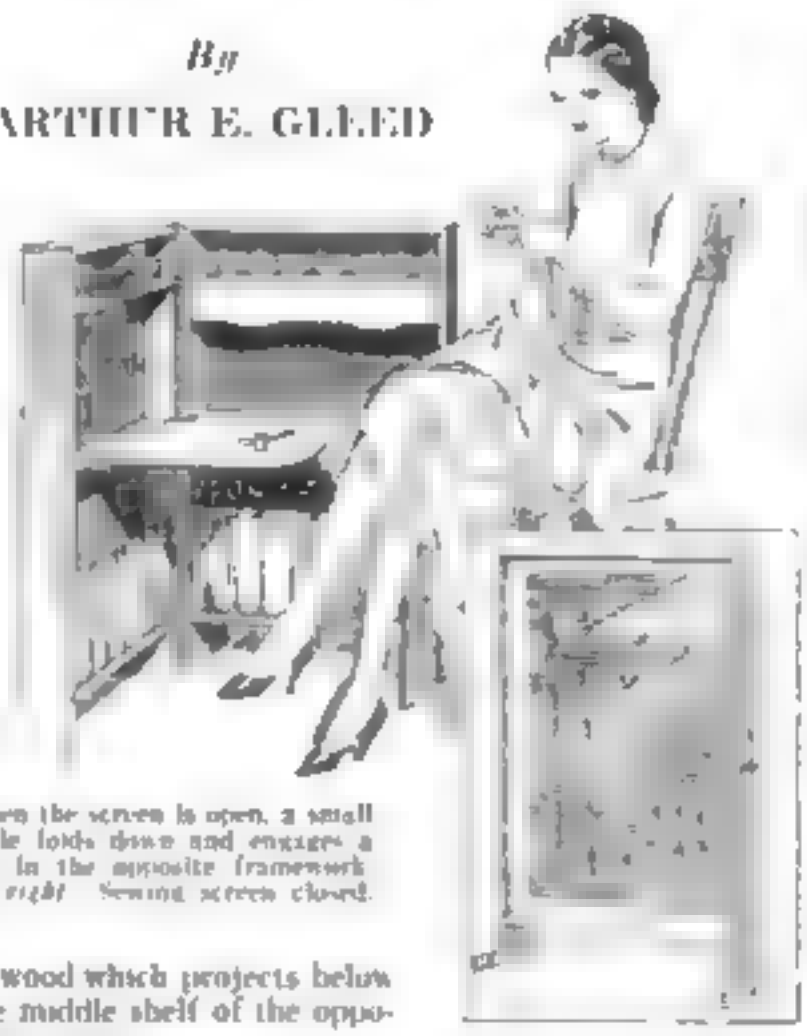
By
ARTHUR E. GLEED

A SEWING cabinet that will hold the many articles required for needlework and can be closed to form a decorative screen when not in use will prove to be a much appreciated gift in most households. Such a cabinet, if made as shown in the accompanying illustrations, offers a rare opportunity to one of artistic taste to add a note of color and distinctive design to the decoration of any room. A noteworthy feature is the small hinged table which lets down when the screen is in use and at the same time locks the screen firmly in the open position.

Oak, walnut, and mahogany give the effect of choice cabinetwork in the hands of a capable craftsman, but one of the softer and more easily worked woods, such as basswood, will be serviceable since it can be stained and waxed to a dull finish, or enameled or lacquered.

Supposing basswood to be used, the two frames should be made of ½-in. material. The shelves and bottom are glued into dadoes (grooves) in the uprights, and the top is rabbeted, as shown. The dimensions are to a certain extent optional. A height of 30 in. and a width of 18 in. are suitable for general use, unless a more imposing screen effect is desired. A depth of 3 in. for each screen will allow for ample fittings, yet this depth, when the cabinet is closed, will not unduly detract from the screen effect.

With these outside dimensions the shelves will be 2½ in. wide. This will allow the main frame to be rabbeted out to a depth of ½ in. to take the front and back panels. In the case of the top shelf, which is fitted for spools, the width must be only 2 in., as room must be allowed for the table when it is tipped up. This table is 12 in. square, the front corner being rounded, and is hinged to the middle shelf. When the table is down, a hole in the top corner engages a pin set in a strip



When the screen is open, a small table folds down and engages a pin in the opposite framework. *At right*, Sewing screen closed.

of wood which projects below the middle shelf of the opposite screen.

The panels are made from three-ply wood, which should be chosen for its pleasing grain if the screen is to have a natural finish. They are fixed in position by rabbeting out the frame to a depth of ½ in. and are held secure with narrow molding mitered at the corners.

The other inside fittings may be varied, but a general arrangement is shown. On the top shelf on one side is a row of brass pins to hold spools of thread. Brass wire hooks could be cut down for this purpose, leaving them 1 in. long. Below the table is a space for a pocket for folded work. The top shelf of the screen on the other side is fitted with a brass rod to hold in place such articles as skeins of silk and cards of mending wool. A small brass curtain rod would serve well for this purpose. The space below has a pincushion and is fitted for scissors and various accessories. Below the shelf which supports the table is another space for a work pocket.

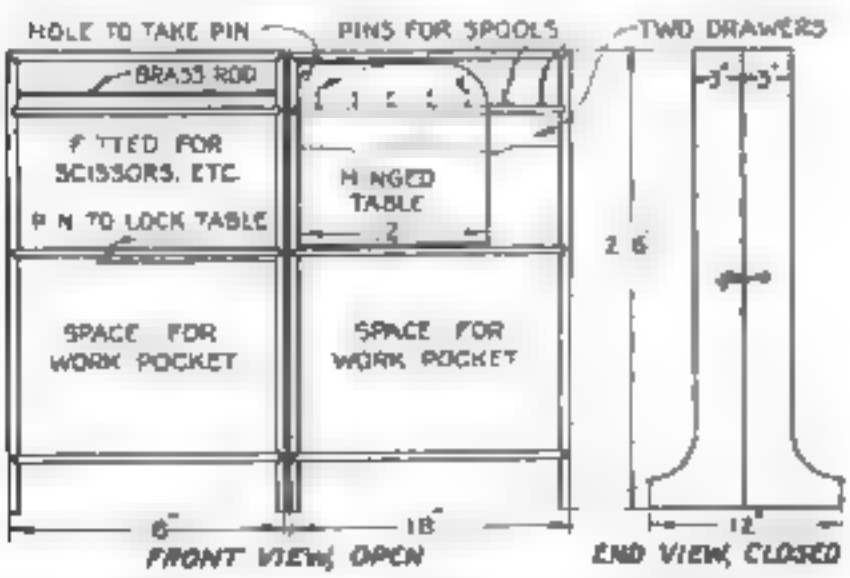
The inside surface of the panels, the work pockets, the pincushion, and the fitting for scissors are all covered with some good quality material, such as heavy silk or a cretonne having a small subdued pattern. This material is glued flat to the panels before they are set in place. As the fitting for the scissors is subjected to considerable use, it should be made up separately in the following manner: Cut a strip of wood ½ in. thick, ¾ in. wide, and long enough to fit neatly within the screen, and glue silk around it. Prepare a strip of cardboard ½ in. wide and cover in a similar manner. Have ready all the articles to be accommodated and lay them in order on the strip of wood. Bend the cardboard strip to form slots to hold each article in position. Glue this securely to the wooden strip between each slot. To add further strength to the slots, screw down the top corners of each with ½-in. roundhead brass screws. Then fix the bar in position on the panel with screws.

The pincushion is made separately in a similar manner. About 3 by 8 in. is a serviceable size, and the lid of a cigar box makes a suitable base. Glue three sides of the cotton covering on to the back of the wood, leaving one end open. When the glue is dry, fill the cushion with bran, well shaken down, then glue down the opening securely. Face with silk material in the same manner, and finally glue the cushion into position.

THE work pockets are made from the silk. The top edge is sewed to a heading which incloses a piece of elastic, the ends of which are fastened to the main frame with screws. The bottom edge is held down by a strip of wood nailed to the lowest shelf.

The design suggested in the illustration is done in stained marquetry, a firm outline being first drawn in pencil and then the spaces being filled in with transparent stains. A final wax finish is given to the whole panel.

Whatever materials are used for making this work screen, care should be taken to adopt a harmonious color scheme. A suitable one would be to stain the screen a soft green, using bronze-green silk for the lining, and tint the landscape design in subdued greens, blues, and brown. An alternative would be to use brown throughout, with warm autumn colors for the landscape. For a gayer effect the framework could be enameled, the inside lined with chintz, and the panel painted, or tapestry could be applied.



Two views of the screen which show its construction and give suitable dimensions. Under the top shelf of the right-hand frame are two shallow drawers for small accessories.

"Build me such a coach as the world has never seen"—*this was Napoleon's command!*

That peerless warrior—Napoleon! Behind him, a record of conquest and achievement that had dazzled the world! Before him, only a few weeks away, the victorious ceremony that would crown him Emperor of France. And now, all about him, the most elaborate of plans and preparations. For *this* coronation must be a *memorable* occasion.

"Build me," was the order to his master craftsman, "such a coach as the world has never seen. A coach more magnificent than was ever dreamed of by the Bourbons. Secure the finest artists, designers, artisans, craftsmen. Bring me something worthy of the glory of my Empire!" *And such a coach as they did build him!*

Today, this "Sacred Coach" of Napoleon is familiar to millions of motorists—for it appears, in modified form, on the world-famous emblem "Body by Fisher." And this very coach has been selected as the model for the coach-building competition now being conducted by the Fisher Body Craftsman's Guild.

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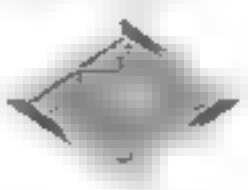
See your nearest Chevrolet dealer, today, and join the Guild. Take advantage of the co-operation Chevrolet is ready to give you. Get started on the model that you will enter in the competition. And win a substantial award!



At the right is the emblem of the Fisher Body Craftsman's Guild. A membership button like this will be mailed to you after you enroll!

CHEVROLET MOTOR CO., DETROIT, MICH.
Division of General Motors Corporation

See pages 10 and 11 for full information about the Fisher Body Craftsman's Guild

CHEVROLET SIX

IT'S WISE TO CHOOSE A SIX

Better Ways to Cut Thin Metal

HENRY SIMON on sawing, shearing, punching, and profiling irregular parts

Cutting can be done in a drill press with the special tool and guide shown in Fig. 9.

IN A FORMER article (P. S. M. Aug., '30, p. 80), the writer discussed ways and means of putting round holes through metal. The present article will deal with producing out-of-round and odd-shaped holes or blanks from sheet metal and plates when single-purpose dies would be too expensive.

Cutting off strips is one of the most common jobs. If a power shear is available, you will have no trouble. If there is not, then the easiest method is that of sawing. Naturally, you will avoid ruining the hack saw and at the same time doing a poor job as shown at *A* in Fig. 1. The simplest correct way of holding work for a power saw is shown at *B*, and for a hack saw at *C*. If the metal is thin and comparatively wide, these methods can still be employed by the help of blocks clamped to the strip as at *D*.

How a number of fairly heavy strips can be successfully cut at once by using a piece of belting placed against the strip edges on the "off" jaw of the vise is illustrated at *E*. Strips too wide for any vise may be cut by the simple rig at *F*. By loosening the two screws *a*, the sheet can be advanced as needed.

The wrong method shown at *A*, Fig. 1, may be corrected as indicated at *A* in Fig. 2 by the application of two blocks of cold-rolled flat stock. This expedient is suitable also for cutting a number of thin strips at once, as indicated at *B*. One block should be slightly sprung, and the saw should be "canted" a little as at *C* to keep its edge hugging the blocks. Round the block edges slightly as shown at *D*.

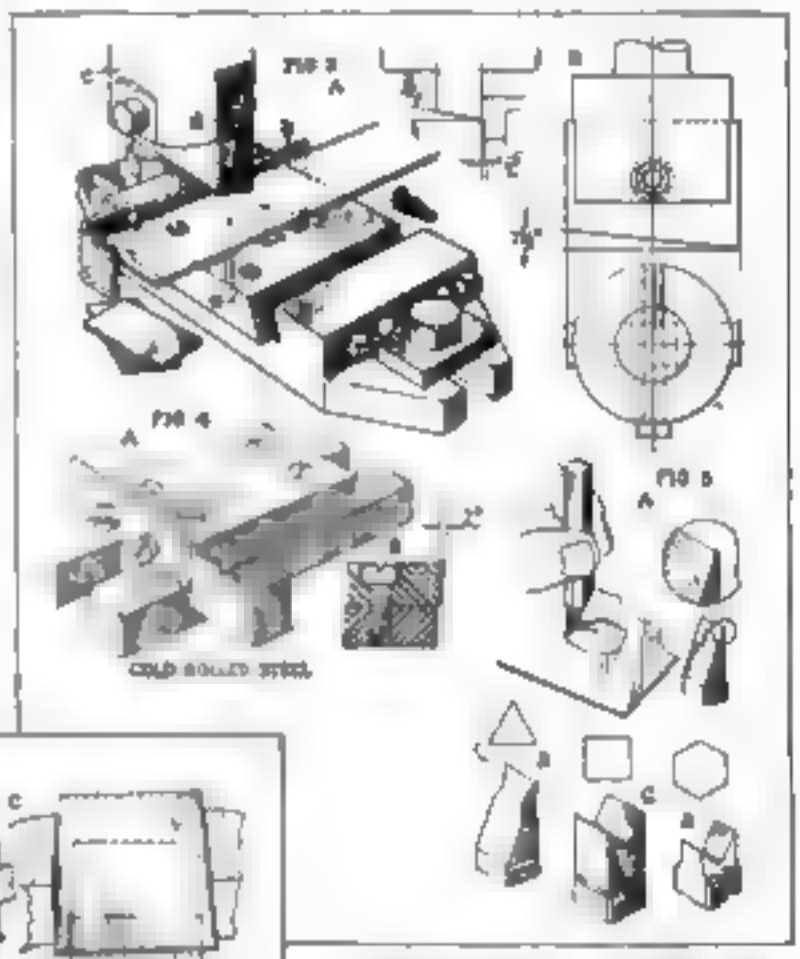
Cheaper in the end than these makeshift blocks is the permanent guide at *E*. It is suitable for hand sawing, but may be adapted to some power saws as at *F*, although the same guide will be usable only with one or the other because of the difference in the thickness of the blades.

Where more cutting is to be done, a shop with any kind of a press can quickly rig up a satisfactory and inexpensive shear from two discarded dies as shown at *A* and *B* in Fig. 3. One good edge of the lower die *a* is trued up with a clearance angle of about 2° and clamped together with a combination stock guide and gage *b* made from strip metal. About the only new part that is likely to be needed is the punch holder *c*. This must be large enough to give a good, solid seat for the blade die *d*, which is pressed in with a light force fit.

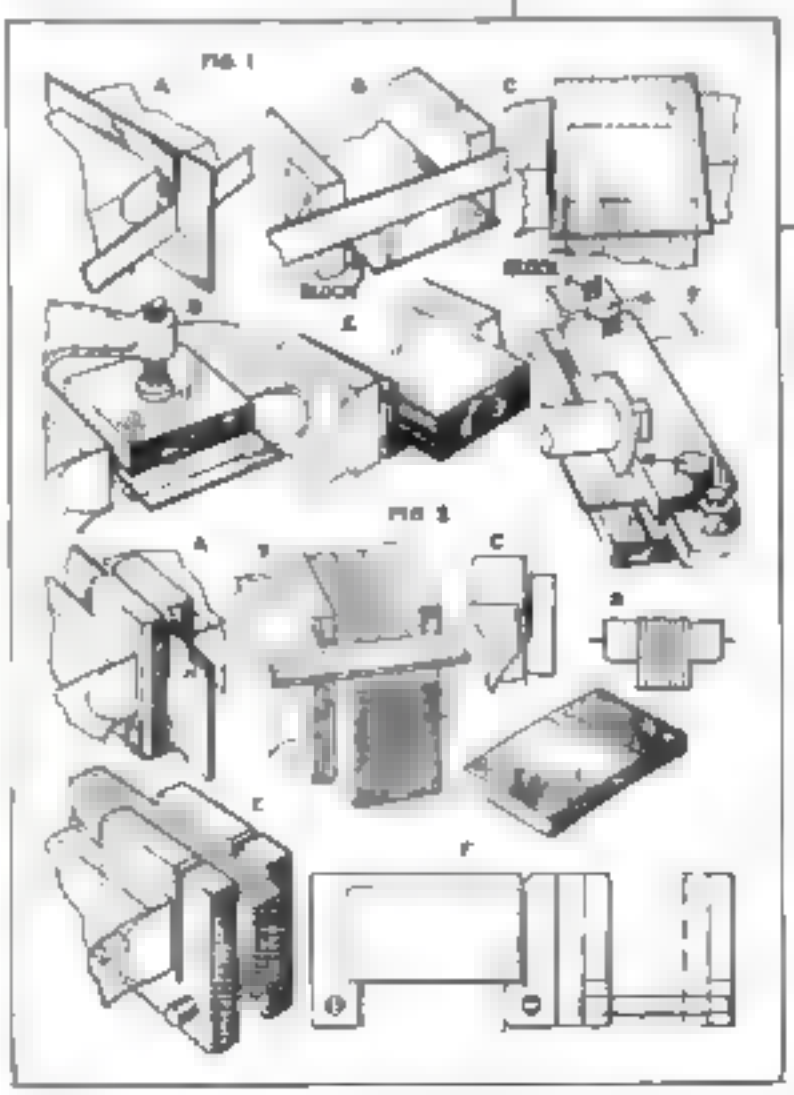
If no die and shoe are available, an inexpensive shear may be made on the simple plan illustrated at *A* and *B* in Fig. 4. The base consists of heavy cold-rolled steel and the blade is a piece of flat tool steel that extends slightly over the base on both sides. The combination stock guide and gage is similar to the one of the previous figure. Either of the gages shown can have only a limited amount of adjustment and new ones must be made for different jobs.

Small square, hexagonal, octagonal, and other polygonal holes, as well as rectangular slots, are often required. If it is only a question of a few small holes in very thin or soft metal, they may be punched by hand to an accurate scratch line by the use of the tools illustrated in Fig. 5, any of which may be ground to shape from lathe bits. Regular polygons with an even number of sides are best made with the double-edge tools at *C* and *D*, which make two accurately parallel cuts at once. A cast-iron, brass, or end-grain hardwood block is used as a pad.

If any number of identical holes of this kind must be produced in sheet metal, it pays to make a die. A simple one that will take care of a number of different sizes of triangular, square, or rectangular holes is that in Fig. 6 at *A*. This die is for use in a regular shoe in any kind of screw or punch press. The form of the stripper plate allows the work to be lined up by eye.



A shear made from two old dies (Fig. 3), another shear (Fig. 4), and hand punch shapes (Fig. 5).

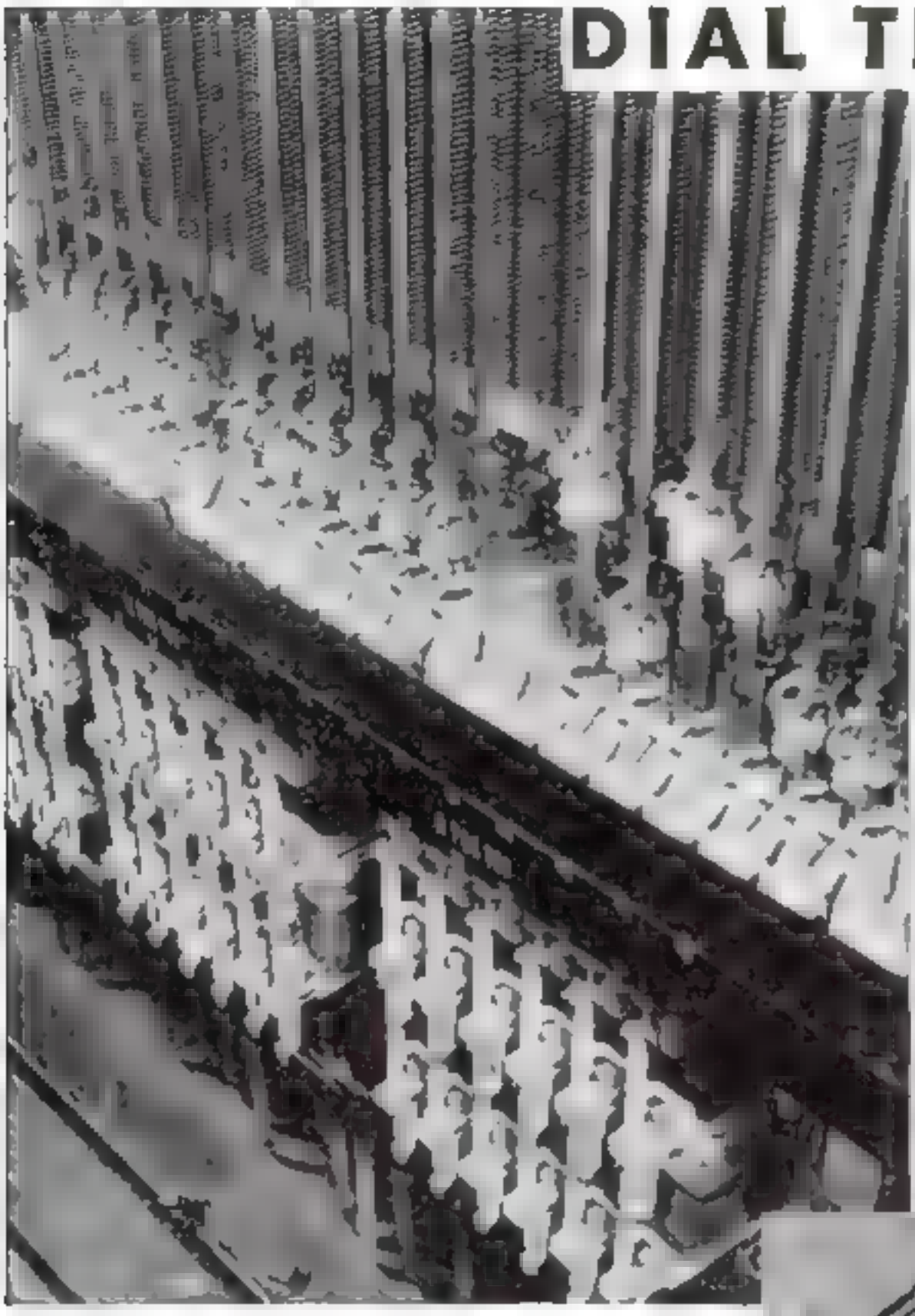


Ways to hold sheet metal for sawing (Fig. 1) and how special blocks can be used to aid the work (Fig. 2).

A universal die that requires considerably more work, but can be set to any exact size square or rectangle within its range, is that at *B* and *C*. This die is suitable for lighter jobs only. In the smaller sizes the blades may be made from high-speed tool-bit stock. Because of the slow wear of such a die and the fact that a damaged bar can be easily replaced, it is practicable to attach the stripper to the frame piece *b*. The stripper *c* should be given ample leeway to "float" by making the holes *d* large.

An adjustable square and

PRECISE MACHINES SERVE DIAL TELEPHONES



In the switch rooms of the big exchanges, complicated mechanism snaps smoothly into action when you lift the receiver of your dial telephone.

On most calls, your finger, dialing the number, is the only human touch. Machines do the rest . . . machines so complicated and so delicate that almost every part must be held within the most rigid limits of accuracy. A mis-adjustment of a thousandth or two in the terminal selectors at the left, for example, would give you a wrong number.

The precision of telephone switching equipment is a matter of scrupulous care . . . and fine tools. Tools like Starretts.

When you use Starretts, you use the same tools that are responsible for the faultless performance of most of the intricate machines which serve our age. In your home shop, or at your serious work, Starretts will bring surer precision to your hands, a new pride in craftsmanship.

In the new Starrett Catalog No. 25 "W" appear over 2500 Starrett Tools, almost all of them designed for wood and metal-working shops. The coupon will bring your copy.

Above: Western Electric Selector Frame, the mechanism which selects the exchange trunk over which your call is routed. Photo, courtesy New England Telephone and Telegraph Company. Right: Starrett Micrometer Depth Gage No. 440, typical of the precision tools which skilled machinists prefer; Starrett Steel Tape No. 530 and Starrett Pocket Slide Calipers No. 425, two of the many Starrett Tools which belong in every kit. Below the coupon. Send it for your copy of Starrett Catalog No. 25 "W"

THE L. S. STARRETT COMPANY
ATHOL, MASSACHUSETTS
Please send me Starrett Catalog No. 25 "W"
Name
Street
City State

50th Anniversary of Starrett Tools 1880—1930

Use Starrett Tools

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rectangular die that is suitable for much heavier work and is more dependable all around is illustrated at *A*, Fig. 7. This tool is particularly well suited to precision slotting. It is simpler in construction than the previous tool, but requires a new set of blocks *a* for each new width. This die also may be made from regular hardened high-speed stock—the main bars from ¼ or ¾ in. square bits, and the narrow centerpieces from cutting-off blade stock. The clearances and angles are shown at *B*. Examples of the work possible with a single set of spacers are given at *C*, and with additional spacers at *D*. The stripper blank appears at *E*, and a universal type of punch holder for use with this die is suggested at *F*.

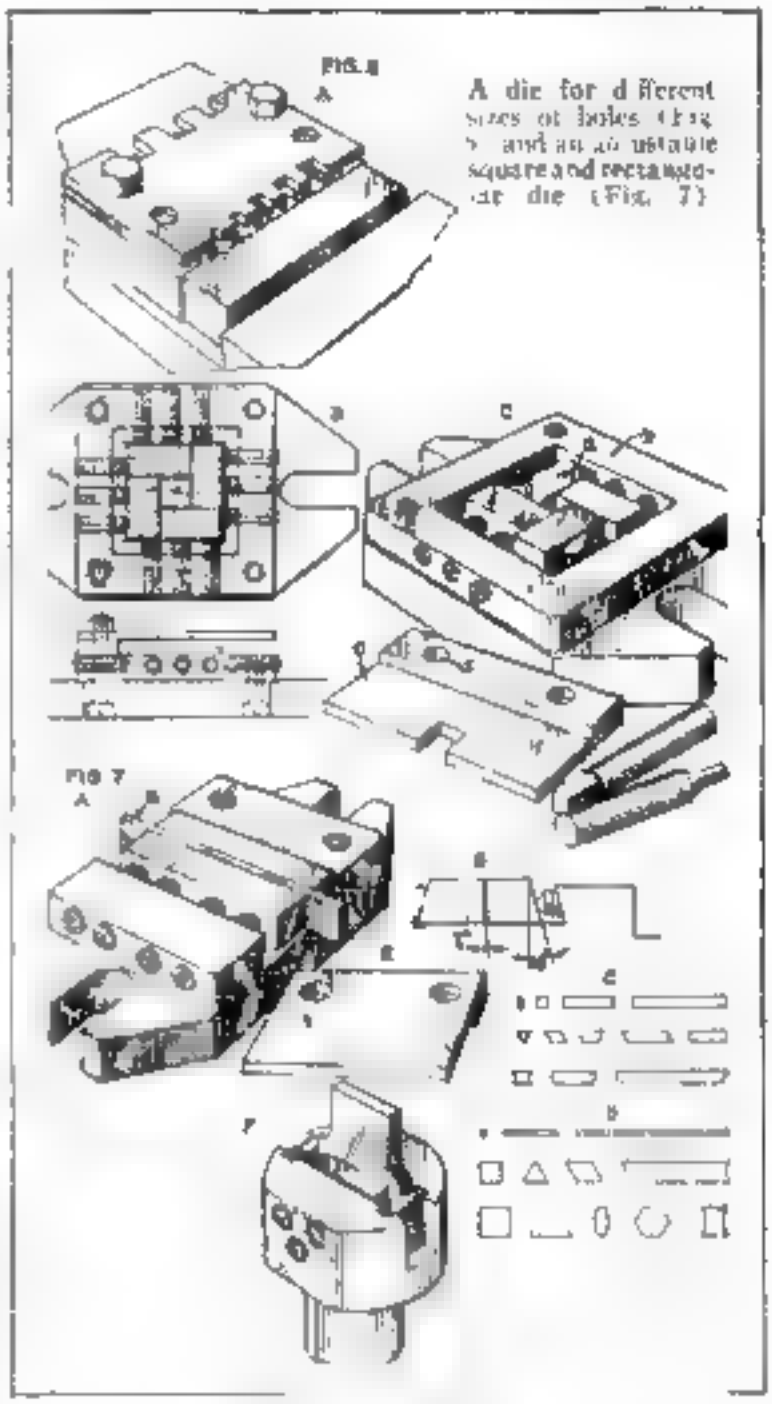
CUTTING sheets and plate metal to an irregular outline is no longer as difficult a job as it used to be, thanks to the nibbling machine and the cutting torch. These helps are not always available in the small shop, however, and moreover, each is not suitable for all gages of work and kinds of material. In cutting screw-machine plate cams to shapes like that of *A*, Fig. 8, for instance, drilling seemed the only way out in the writer's shop until he designed a simple outlining punch that did a better job in ten minutes than had previously been possible only through hours of drilling.

Figure 8 gives the details of a simplified and improved design of this device which is adaptable to roughing out a blank or an irregular hole of almost any shape and in any material from 1/64-in. brass to ½-in. steel plate. The tool has a cast-iron base *a*, in which a round die *b* is maintained flush with the top surface *c* by means of blocking washers. The stripper *d* may be set to any distance from the die by interchangeable spacers *e*, in accordance with the material being handled.

The position of the punch is indicated by a finger *f*, which is held on the work in a position corresponding to the die opening while the punch is up, but sidesteps each time the punch descends. This is accomplished by the construction seen in detail at *C*. The finger *f* is fastened to a lever *g* pivoted at the foot in a plate *h*, which is screwed into a recess in the bottom of the die. A leaf spring *i* keeps the finger-position adjusting screw *j* in contact with the bottom of a notch *k* in the stripper *d* while the punch is up. The punch holder *l* is made with a tapering end, which in descending forces back the lever *g*, thereby moving the finger before the punch can strike it. The clearances, punch and die sizes, and hardening data are given in the diagram *F*.

The work should be marked with a plainly visible scratch line. A full round hole is punched for a starter, but successive holes are overlapped, as indicated at *D*. The finger point makes it possible to punch close to the line. As will be seen from *E*, far less metal is left for removal by grinding than is the case when a drill is used. Moreover, punching each hole is a matter of only a second or two in the heaviest plate. The saving in time thus made is so great that even a very few jobs pay for making this device.

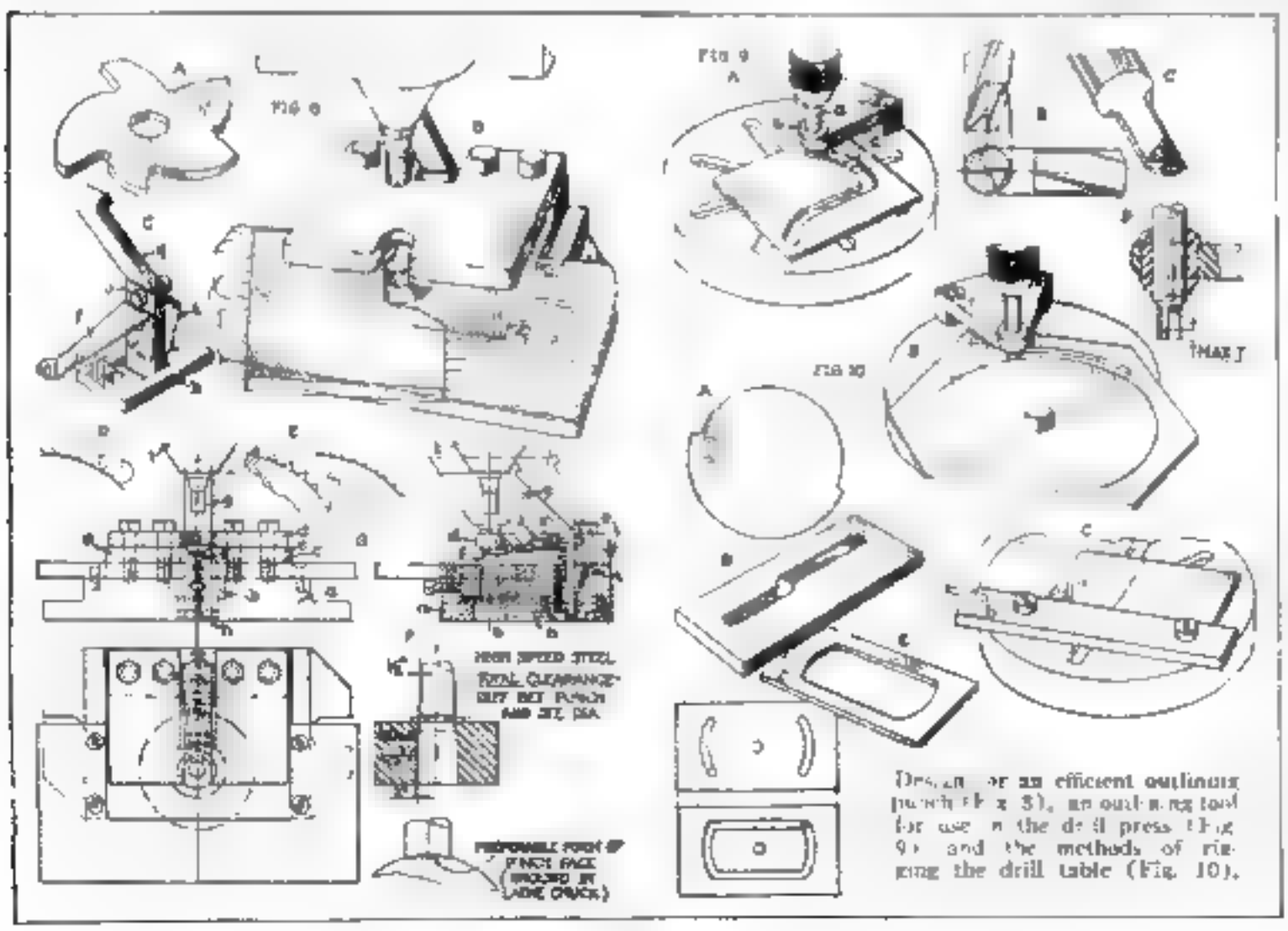
A different kind of "outlining" tool is that of Fig. 9. While it has less power and speed, it leaves even less waste material and is also suitable for producing grooves. The cutter, which revolves in the same way as a regular slotter, may be either an ordinary twist drill ground as at *B* or preferably, a special tool as at *C*.



A die for different sizes of holes (Fig. 8) and an adjustable square and rectangular die (Fig. 7)

As shown at *A* in Fig. 9 the tool *a* is used in an ordinary high-speed drill press and is guided close above the cutting end in a regular drill bushing *b*. This bushing is set in a heavy "arm" *c* that is firmly clamped or bolted to the drill table. The tools, which should be of high-speed steel, should be run at surface speed about 50 percent higher than would be employed with drills of the same size. The diameter of the cutting point should usually be between 1/16 and ¼ in., because larger points remove too much metal and make it difficult to guide the work. In each case, the depth of a single cut should not exceed half the diameter of the cutter, according to the detail at *D*.

Some special ways of rigging the drill table for use with this device are shown in Fig. 10. At *A* and *B* is indicated how disks or concentric circles may be generated by a simple expedient. At *C* is a plain guide for accurately producing straight and parallel slots in a straight piece. An example of grooving is illustrated at *D*. In many cases, two or more such guiding methods may be combined, as in the case at *E*.



Design for an efficient outlining punch (*B* to *E*), an outlining tool for use in the drill press (Fig. 9), and the methods of rigging the drill table (Fig. 10).

Brown & Sharpe Gauges

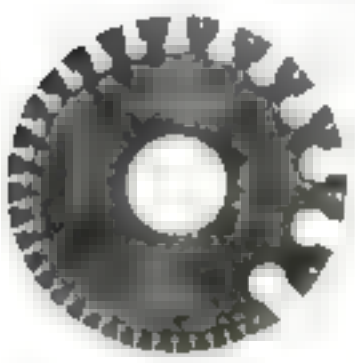
--a type for every class of work

IN the daily work of skilled mechanics, from manufacturing control to repair work, Brown & Sharpe Gauges are in constant use. It may be to measure the accuracy of finished parts, to check important clearances, or to select the proper size of tools or materials for the job.

Whatever the requirements, there is a Brown & Sharpe Gauge which will simplify the work — standard plug and ring gauges, standard caliper gauges, vernier height and depth gauges and many special gauges designed for some particular job.

Below are described several Brown & Sharpe Gauges which occupy an important place in the kits of skilled mechanics.

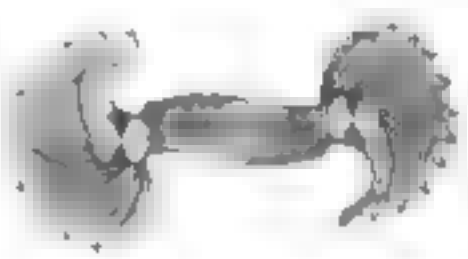
American Standard Wire Gauge
No. 688



A particularly useful tool for gauging sheets, plates and wire of non-ferrous metals.

Decimal equivalents are stamped on the reverse side.

Screw Pitch Gauge
No. 630



For quickly determining the pitch of threads of bolts and nuts.

For "V" Threads. 22 pitches—9 to 40 including Pipe Thread Pitches. Shape of blades permits their use on nuts as well as screws.

Universal Surface Gauge
No. 621

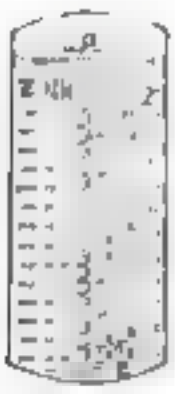
A particularly handy tool for set-up work.

Knurled adjusting screw permits a wide range of adjustments. V-shaped bottom adapts it for cylindrical work.

Thickness Gauge
No. 644

For checking clearances accurately.

Nine tempered blades — .0015, .002, .003, .004, .006, .008, .010, .012, and .015 of an inch. Blades 3" long, ½" wide.



Twist Drill and Machine Screw Tap Gauge
No. 707

Gauge tells the correct drill to use with any common size of machine screw tap.

Planer and Shaper Gauge
No. 625

With this gauge the cutting tool can be adjusted in a minimum of time. Can be used either on its base or its side.

The full line of Brown & Sharpe Gauges is included in Small Tool Catalog No. 31 which describes over 2300 useful tools. Ask your dealer for a copy or send to us for one. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

Brown & Sharpe Tools

"WORLD'S STANDARD OF ACCURACY"

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What many years of practice have taught me about

Making Laps for Toolroom Work

By HECTOR J. CHAMBERLAND

A small magnifying lens, held in a support, is a genuine help in inspecting a lapped finish for flaws.

LAPPING operations in the toolroom are not a question of metal to metal contact, as in the case of the bearings and gearing previously discussed (P. S. M., Sept. '30, p. 86), but rather one of precise dimensions.

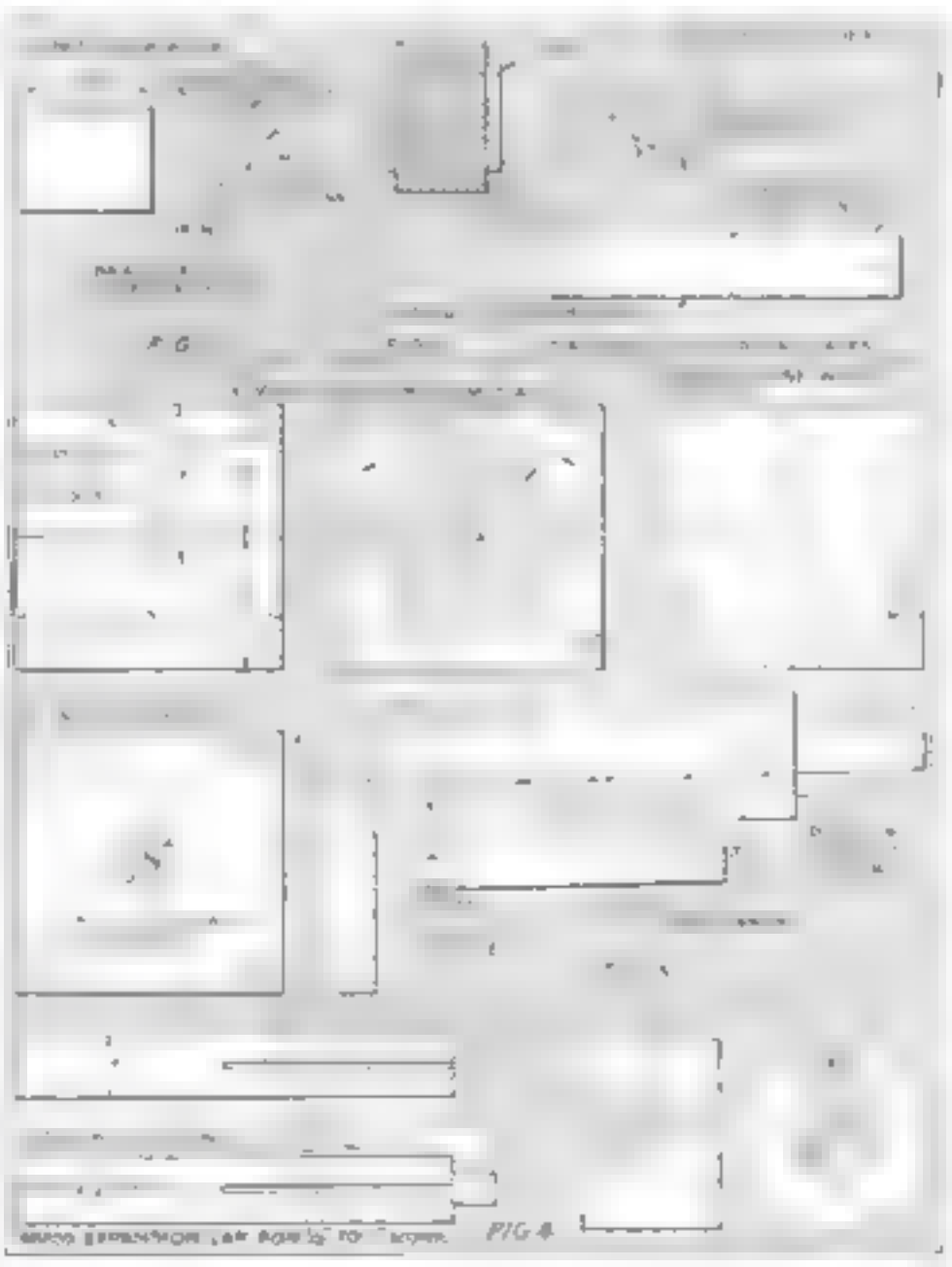
The toolroom is called upon to make a variety of plug, ring, and snap gages, and also small bushings, pins, and studs for interchangeable fixture parts. To maintain standardization, it is, of course, necessary to have comparator gage blocks and to observe the requirements in regard to temperature. Comparator gages will contract or expand, but they will always maintain their standard at temperatures between 65° and 70° F.

For lapping plug gages, wrist pins, and studs, all that is needed is a brass split bushing (Fig. 1) with the bore smoothly finished to the size of the gage and the length of the lap being about one half that of the work. Any such part to be lapped should have a bright grinding finish with an allowance of no less than .0003 in. nor more than .0005 in. After a compound such as H-40 fine (to use the Carborundum system of designation) has been applied, the work should be revolved on centers at a medium speed and the lap should be oscillated and kept moving back and forth across the work.

A test for size ought to be made every minute after thoroughly cleaning and wiping the part. Do not take chances as the size is sometimes reached very rapidly. Plug gages are expensive, and one that has gone undersize is of little value; on the other hand, it is many times advisable to favor it one or two "tenths" (ten thousandths of an inch) and prolong its use.

Until recently, worn plug gages went to the junk pile, but chromium plating has reached such a state of efficiency that they are now being reclaimed by being plated. So uniform is the plate after the surface has been ground cylindrically that the gage may be lapped with the same excellent results as a new one.

Ring gages are usually made as in Fig. 2. The shoulders are a protection against bellmouthing in the grinding operation and are removed after lapping. A satisfactory lap for fine internal cylindrical work may be made of brass. It should be left long enough to be double-ended and centered, turned, and ground. One end should be finished to fit the ground size of the bore, the other being .0002 in. under the required finished size. After applying the same compound as in the previous operation and revolving the lap at a medium speed, the gage is oscillated with the palms of the hand so as to obtain a complete revolution in every four or five movements. This is done until the bore fits the large end of the lap. All gages should be polished with felt.



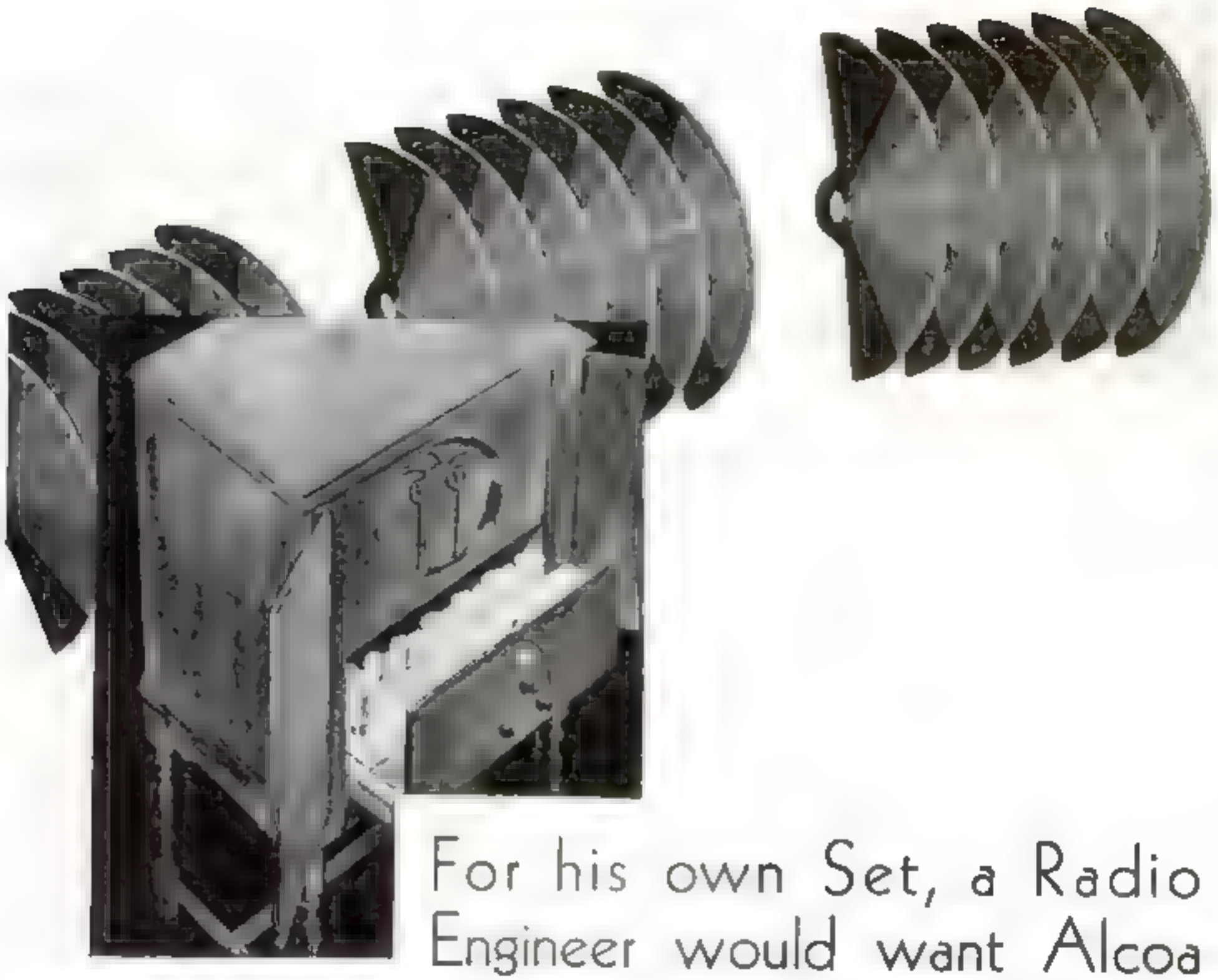
Suggestions for internal and external laps, and the method of constructing a mold for lead laps. For accurate work a lap must be well made.

FOR the average run of standard internal lapping, a lead lap is the most economical. The initial cost lies in making the mold, but this is a good investment. Medium work to be lapped is mainly between 1 and 2 in. The mold shown in Fig. 3 has a 2⅛-in. bore, and the plug arbor is given a Brown and Sharpe taper. As there is no actual waste it is advisable to cast a set of sixteen; this will accommodate the ¼-in. sizes and leave an ample supply for odd dimensions. After casting the set, the taper holes are smoothed up with a reamer, and the laps are turned to their respective sizes. When turned, they are split with a 1/16-in. saw in the milling machine.

For work from ¼ to 1 in., the expansion brass or cast-iron lap in Fig. 4 is satisfactory for standard sizes. For odd dimensions, a plain double-ended lap finished to suit this special requirement is generally used; and such a lap is also recommended for operations under ⅜ in. because the cost is small. In all cases these laps should run on centers for the best results.

As the ordinary line of lapping work is made up of plain bushings, collars, and the like, a compound such as H-40 coarse should be used for quick results.

To finish snap gages of the flat type and retain the parallelism obtained through the grinding operation it is advisable to use the honing process. Allow .0002 in. on each surface. After the contacts have been given a coat of coppering acid, and the gage has been placed in a suitable vise the honing may be done with the aid of a magnifying glass in a support. A fine oilstone of the triangular type is a good one to use.



For his own Set, a Radio Engineer would want Alcoa Aluminum Condenser Blades

It is well known in the radio industry that no type of blade for variable condenser work is more efficient than the all-aluminum blade.

These blades are non-microphonic; aluminum stays put and does not warp, thereby bringing clear tone and increasing the volume and sensitivity of the set.

Don't let cost-shaving in manufacture interfere with the efficiency of your new set. Make sure that it has all-aluminum condenser blades. It is your assurance that the builder used the finest material.

Alcoa Aluminum has many uses in radio sets. Weighing ⅓ as much as other metals, it insures that parts are extremely light. Thus they are less liable to be thrown out of alignment in shipping. They remain true in both shape and adjustment.

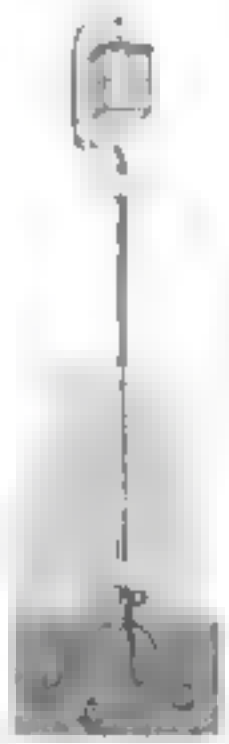
Look for Alcoa Aluminum condenser blades and foil condensers—also Alcoa Aluminum shielding, wire and other parts. Ask your radio dealer to open the set up and show these important working points. ALUMINUM COMPANY of AMERICA, 2496 Oliver Building, PITTSBURGH, PENNSYLVANIA.

ALCOA

ALCOA ALUMINUM

THE METAL THAT IS *TUNED* TO RADIO

Copper Braid Decorates Lamp Stand of Pipe

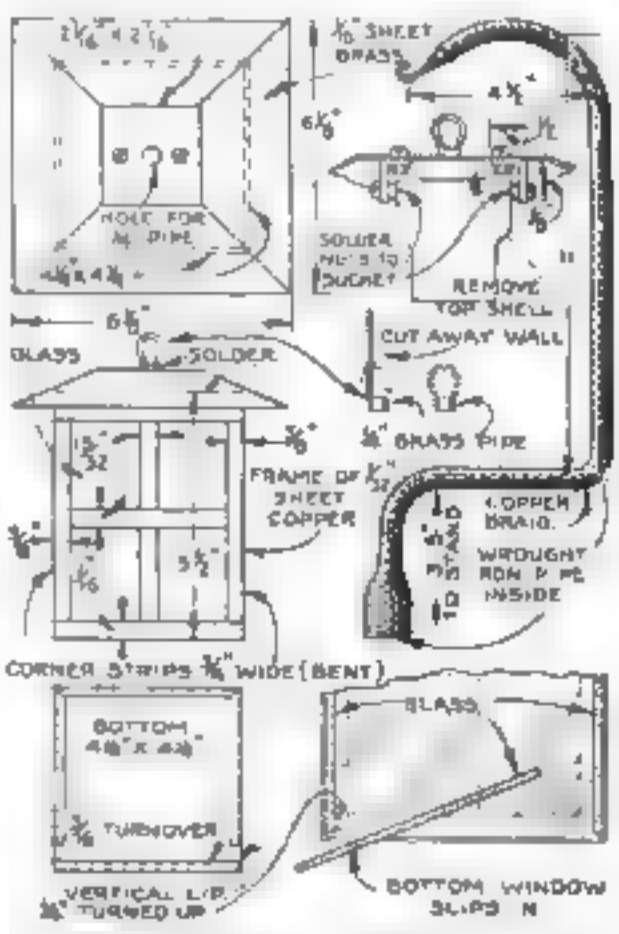


An ingeniously designed lamp.

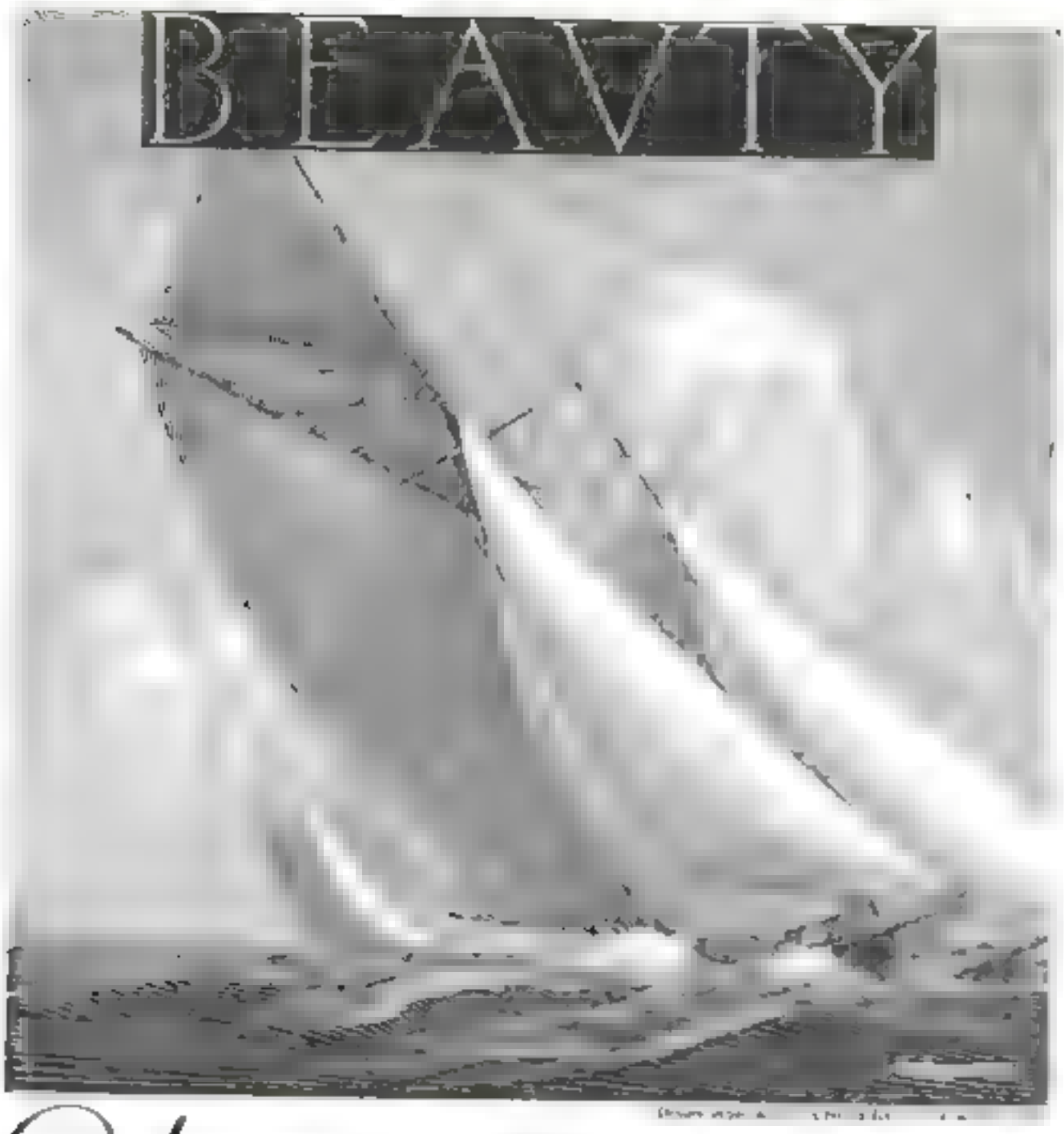
NO ONE would guess that the standard of this unusual floor lamp is merely pipe. Yet that is all it is. The secret of its attractive appearance lies in the fact that 1-in. copper braid was opened up to form a tube and slid over the entire standard.

The lower part of the stand is made of ¾-in. wrought iron pipe; the upper of ⅛-in. brass fixture pipe. The base was obtained from the scrap pile, but if one cannot be acquired from this source, a wooden or wrought iron base can be made to suit the constructor's taste.

For the upper ornament on the standard, a brass collar is used, with brass decorations soldered to it. The lower ornament is made of No. 6 copper wire and held in place by two 1-in. brass collars. The top of the shade is brass, but all the rest of the framework is cut from copper sheet or strips. The glass, which was purchased for 75 cents, is imported opal. The pieces are held in place by means of small copper strips ⅛ by ¾ in., half soldered to the frame and half bent over the glass. The glass rests on the 3 16-in. turnover on the bottom of the frame. A 15-watt lamp will be found to give sufficient illumination.—L. DUTTON



Details showing how the stand is covered with copper braid and the shade is made.



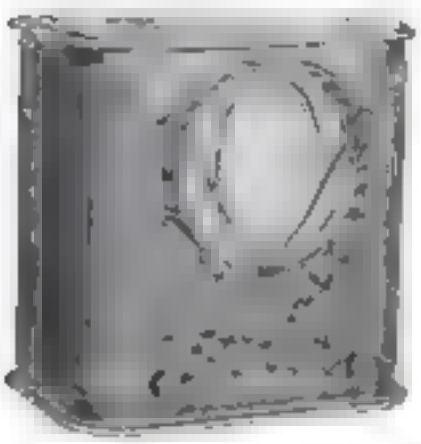
You're there with a CROSLEY

BEAUTY . . . a spanking breeze and the long, toiling eloquence of tangy water across which white sails glide with incredible speed in a pageant of endurance. There is a cup to be won, and well to the fore this great, gleaming gull spreads her fourteen thousand feet of snowy canvas with an eagerness be-speaking her lineage. The *will to do*—the stamina, the scientific principle of every essential part, has been *built into her*. She *must* win! And *does!*

BEAUTY . . . radio, as it is, one of the most astounding inventions of an astounding age—voicing, as it does, all of the beauties and musical intricacies of the centuries—calls for beauty, as well, in physical aspect. In the new Crosley radio receivers BEAUTY has been made the keynote—they denote a new era of the truly beautiful in radio cabinet design and construction. Beauty of reception-quality is characteristic of them, too. To such painstaking design and manufacture comes, naturally, the sure reward of leadership—the cup-winning ability. There is, after all, sheer beauty—super-excellence of mechanics—superlative performance—*built into* Crosley radio. It *must* win—it *does!*

THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., Pres. "Home of the Nation's Station"—WLW
CINCINNATI

Also manufacturers of CROSLEY Battery Radio Receiving Sets, the CROSLEY ROAMIO Automobile Radio Receiving Set, and the famous AMRAD RADIO



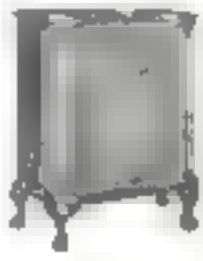
The NEW Buddy

An exquisite table, mantel or clock type self-contained receiving set, with power speaker only 12" high, 15 ¼" wide and 9 ¼" deep, so small in size and light in weight that it is easily moved from place to place. Contains the same type receiving set as The PAL and The MATE. Employs three Screen Grid tubes. Nothing ever equalled it at so low a price . . . . . $64.50 WITH TUBES

The CROSLEY NEW Companionship Series

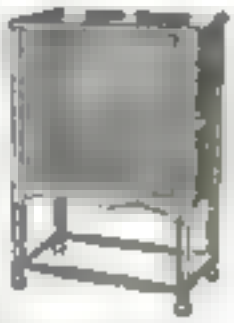
SCREEN GRID • NEUTRODYNE
POWER SPEAKER • A.C. ELECTRIC

The Pal



A marvelously beautiful cabinet 25 inches high, suitable as a radio stand, book stand or occasional table. Contains the same receiving set and power speaker as The MATE and employs same number and type of tubes. The price is amazingly low for the quality and performance . . . $69.50 WITH TUBES

The Mate



A delightfully designed and executed cabinet that harmonizes with any surroundings in the home. It contains an entirely new screen grid and power speaker. Employs three type -24 Screen Grid tubes and type -45 and one type -80. The unusual value of The MATE at the extremely low price . . . . . $75.00 WITH TUBES

The CROSLEY NEW Leadership Series

SCREEN GRID • NEUTRODYNE
POWER SPEAKER • A.C. ELECTRIC

The Director

A particularly beautiful cabinet containing a receiving set employing three Screen Grid tubes type -24, one type -27, two type 45, and one type 80. Push-pull automatic volume control, local-distance switch and dynamic power speaker are features of this set. Astonishingly low in price . . . $107.50 WITH TUBES

The Arbiter

Electric Phonograph and Radio Combination

A truly versatile instrument that provides complete entertainment for any occasion in the modern home, complete in a cabinet of superlative beauty. The same super-selective and sensitive radio receiving set and dynamic power speaker as in The DIRECTOR. A marvelous electric phonograph and radio combination for what you would ordinarily expect to pay for a radio receiving set alone . . . $137.50 WITH TUBES

Also available with induction type self-starting motor at $147.50

CROSLEY RADIO

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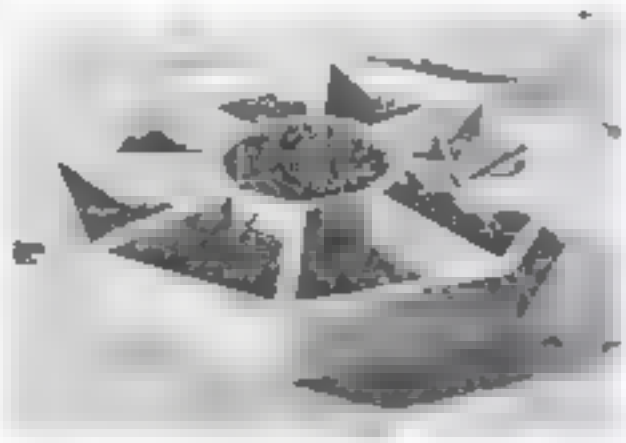
Revolving Nail Box for Your Bench



Time may be saved by keeping an assortment of nails in this octagonal turret-type box.

ONE way to save time and temper in finding the right nail or screw is to construct for your workbench a turret-type nail box similar to the one illustrated. This particular box has eight sides, each 5¼ in. long, the parts being as follows

One octagonal base of ½-in. poplar or other wood, measuring 5¼ in. on a side. You will find it convenient to cut a card-

The ½ in. thick bottom of the nail box after the shape has been marked and cut

board pattern to use for laying out the wood. Several narrow boards may be joined, if necessary, with corrugated fasteners.

Eight side pieces, each ½ by 2 by 5¼ in. The length is measured on the outside, and the ends are cut to an angle of 67½°.

Eight partitions, each ½ by 2 by 4⅝ in. One end is beveled equally on both sides to 67½°.

Eight short pieces for the center compartment walls, each ½ by 2 by 1⅝ in. The 1⅝-in. length is measured on the longer side, the ends being beveled to

The base is a friction-top tin can, not too high, weighted with either sand or concrete.

"Substitute Nickel for Platinum! we can do Better *than that*..."

When the radio industry was young and only a few thousand technically minded enthusiasts were hooking up receiving sets, radio tubes were a laboratory product. The use of costly platinum-iridium for their filaments was not a handicap. For comparatively few tubes were in demand.

Westinghouse engineers, however, foresaw a serious situation. When millions of radio sets came into use there would not be enough platinum available to make the tubes they would need. A substitute material just as satisfactory must be found. Westinghouse laboratories set out to find it.

Soon a young engineer reported that nickel would meet the requirements. From a practical standpoint it made as good filaments as platinum. It would do. But Westinghouse engineers said If a pure metal is as good as platinum, it should be possible to produce an alloy that will be far superior.

Months of tireless research and experimenting followed — development work that called into play the broadest scientific knowledge. Eventually the ideal combination of metals was produced, Konel metal, stronger than any alloy steel, and far superior to platinum as a core for oxide-coated filaments in radio receiving tubes.

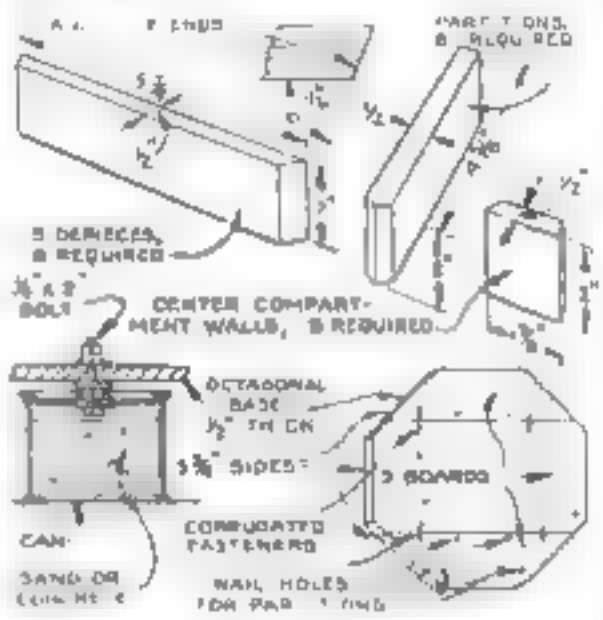
If sufficient platinum were available it would take more than a quarter of million dollars worth to take the place of the Konel metal used in vacuum tubes each month. And vacuum tubes are only one of its possible applications. Konel metal meets severe service requirements such as those confronted in gas engine valves and spark plugs. Its commercial possibilities have only been touched

Tune in the Westinghouse Salute over WJZ and the coast-to-coast network, every Tuesday evening.

Westinghouse

673 Another way to form the center compartment is to cut a 2-in. length from a tin can and mount it in the center. The partitions should then be cut long enough to fit against the can sides, which are nailed to them.

One tin can with a friction top about 3 in. high and as large in diameter as obtainable. Fill this with sand or con-



How the tin, partitions and base are cut and assembled, also showing the pivot

crete to serve as a weighted base upon which the box revolves.

One machine bolt ½ by 2 in. This is mounted in the center of the can lid and projects upward through a hole in the center of the nail-box base. Three nuts and five washers are used, one nut to hold the bolt to the can lid, and the other two to act as a nut and lock nut on top of the baseboard. You may find it necessary to solder the can lid in place so that you can pick up the box without losing the base. Finally, paint the box inside and out, using green, blue, or some other attractive color.—WALTER E. BURTON

INSULATING TEMPORARY WIRE CONNECTIONS

IN TESTING or laboratory work, electrical connections are often made which are to be used for so short a time that taping is hardly justified, yet they should be insulated in some way. Before making such connections, slip short lengths of rubber tubing over the insulated wires. Then

Rubber tubing used to insulate splices, and a hose covering for welding-cable connector

make the splices and push the tubes along to cover the bare connection. Short pieces of garden hose can be used similarly for welding cables and other heavy wires when they are connected by "knuckle" or "pivot" type cable connectors.—T. R. WATTS.

Every Camper's Ax Deserves *a Good* Sheath

By F. CLARKE HUGHES

Neat and durable homemade sheath for a camper's ax

NO CAMPERS ax is complete or safe without a sheath such as the one illustrated. It is easy to make and requires only one piece of light but good grade sole leather 5½ by 10 in. This may be purchased at any shoe shop, and half a dozen ordinary tubular rivets should be obtained at the same time.

The sheath is made in three sections. That marked No. 1 includes the back, top, and flap; No. 2 is the front; and No. 3, the end of the sheath. As in the case of the hunting knife sheath (P. S. M., Aug. '30, p. 102) and the other articles previously described in this series of articles, it is best to make a paper pattern to fit the ax before marking the leather.

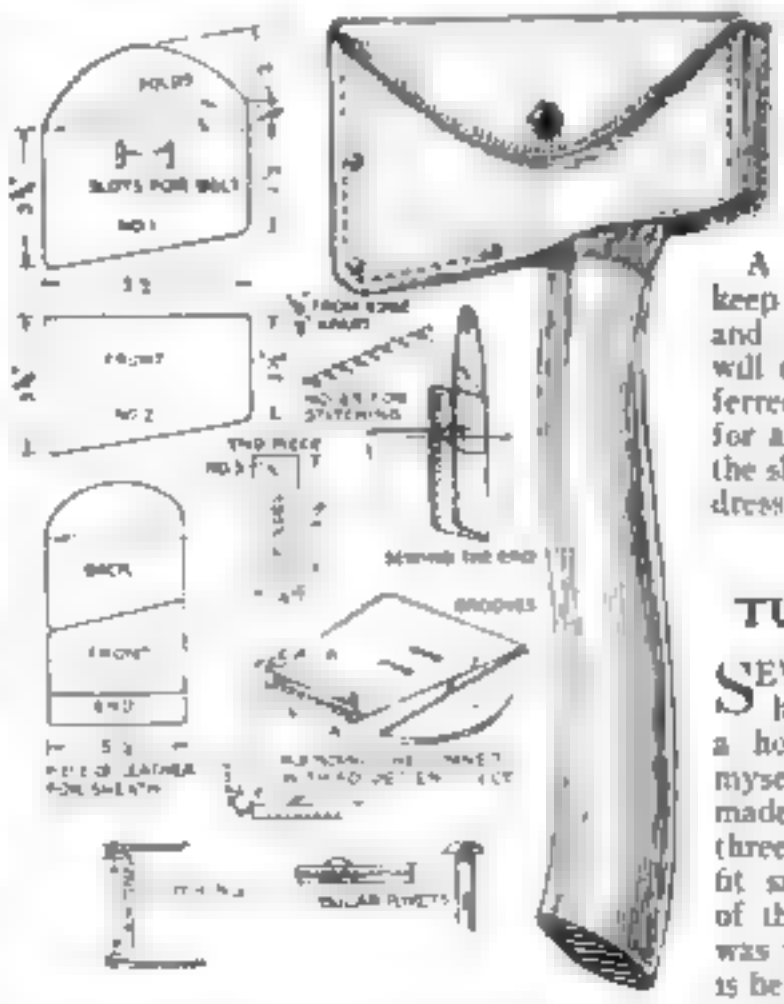
Piece No. 1 should be slightly grooved or veined along the fold lines, the grooves being made with either a woodcarver's small veining tool or with a sharp penknife. Slots should be cut as shown in the section which is to become the back of the sheath, these are to allow it to be attached to a belt.

The stitching for the ends is of the same type as that described in preceding articles. It should be done with a double needle along a line of holes made with a very slender awl. If a small line or groove is tooled along the line of stitching, it will aid in placing the stitches and will keep them in a straight line. The stitches should be about ⅛ in. from the edge and ¼ in. apart. If a piece of luggage or any article made of heavy leather is studied the professional method of doing the hand sewing will become plain.

The best point to begin the sewing is at the thinner end of the sheath, where the front meets the back. At the thick end, the extra end piece must be carefully fitted, especially where it turns the oval corner. One of the sketches shows how this may be done.

When the sewing is completed, the rivets should be inserted as indicated to guard against the danger of cutting the stitching with the edge of the ax.

A snap fastener may be used to keep the flap shut, or a small strap and buckle from an old wrist watch will do equally well. If a snap is preferred, a shoemaker will put one in for a few cents. When all is finished, the sheath should be polished with shoe dressing or floor wax.



Patterns for the three parts; how the stitching is done and the rivets inserted; the completed sheath.

TURNING SET SCREWS

SEVERAL times on repair jobs I have needed a wrench to remove a hollow-head set screw and found myself without one. A substitute was made by grinding off the tang of a three-cornered file to a length that would fit snugly into the broached opening of the set screw, and a pair of pliers was used to turn the file. As the tang is hexagonal and tapering, it is possible to use a small triangular file for almost any size set screw.—V. C. DARBY

For kitchen or breakfast room—

A Modernistic Handy Table

By
DONALD A. PRICE

The finished table. An equally pleasing effect is obtained by reversing the colors.

List of Materials

Mk.	No.	Description	T	W	L.
A	4	Leg sections	¾	1½	26½
B	4	Leg sections	¾	¾	20
C	8	Leg trim (taper to $^3/_{16}$)	$^5/_{16}$	¾	19½
D	8	Leg braces (4 right-hand 4 left-hand)	¾	3½	$7^3/_{16}$
E	2	Edging	¾	2	20
F	2	Edging	¾	2	18½
G	1	Top strut	¾	2	18½
H	1	Top, 3-ply fir panel	¼	20¼	20¼

All dimensions are in inches.

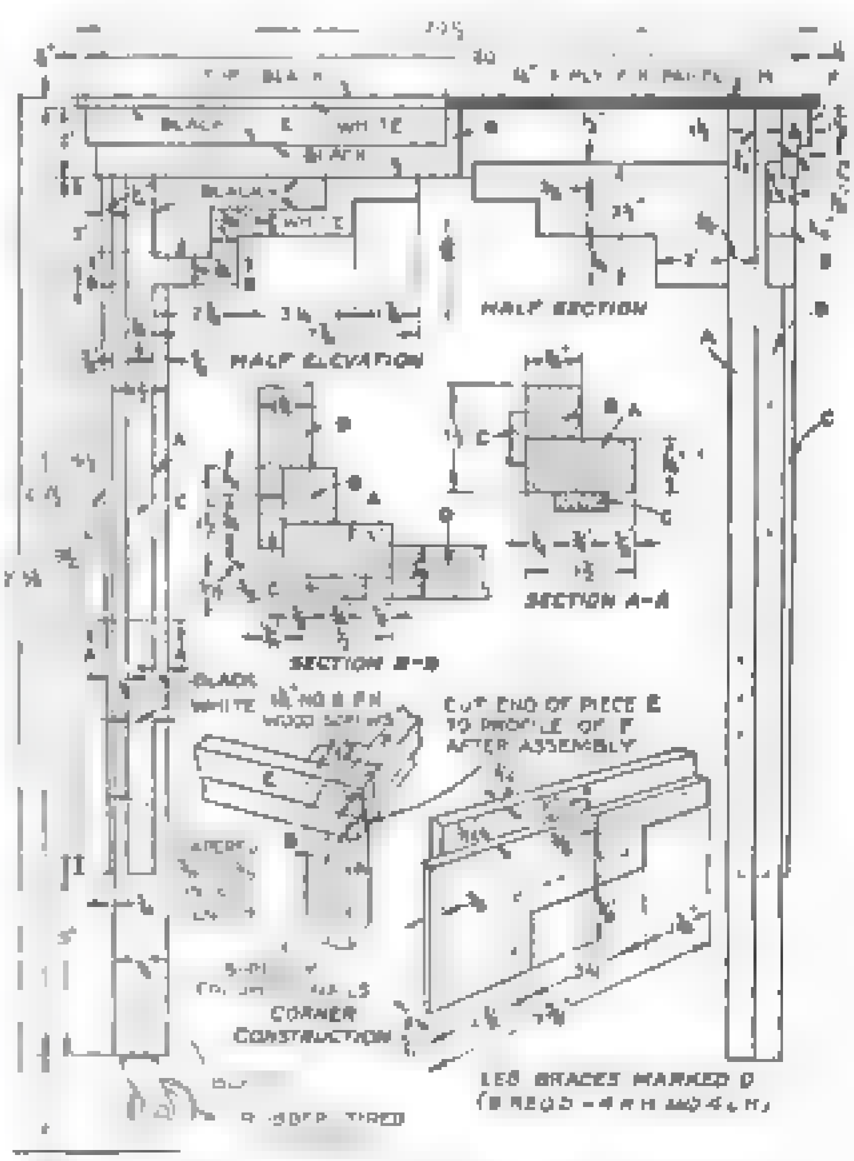
HERE is an easily constructed small table for general use in a kitchen or a breakfast room. As it is mounted on rubber tired casters, it can be readily moved around where wanted. For example, dishes can be piled on it after being dried and the whole load pushed over to the china closet for storing. Another use is as a side table for the electric toaster, percolator, or waffle iron.

With the exception of the three-ply panel top, it is constructed entirely of packing box lumber ¾ in. thick. All parts, with one exception, are put together with nails and glue, the nails being set below the finished surfaces and the holes filled with a prepared wood putty. The exception is at the joint between the legs and the rails, where screws are used as shown in the sketch of the corner construction.

The legs, of course, could be made of a 1½ in. square piece of wood instead of being built up as shown from parts *A* and *B*. In the original table these pieces were bradded and glued together in order to utilize the ¾-in. wood obtained from packing boxes. This construction, by adding more lines and surfaces, also tends to make the finished table more interesting from a design standpoint.

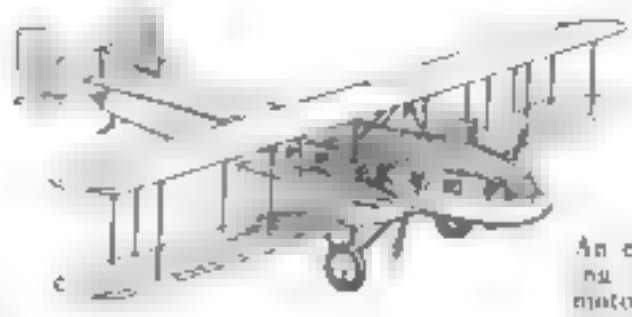
The part *D*, of which a perspective is shown, looks complicated, but a little study will reveal that it is a simple matter to cut the rabbets on the top and the end with the circular saw and the notches on the bottom with a fine toothed back saw. It is bradded to parts *E* and *F* from the inside through the upper projection and to the legs from the outside through the end projection. After assembly, a groove separating the ¾-in. black band on part *D* from the white is ruled in with a scratch awl.

The color scheme is indicated on the drawings as black and white, and the entire underneath and interior portion is painted black, however, any contrasting colors may be used with good effect. Lacquer is the quickest finish to apply.



Working drawings with parts lettered to correspond to the list above. Packing box lumber is used for all but the top.

Constructing a Realistic Model of the Curtiss Condor

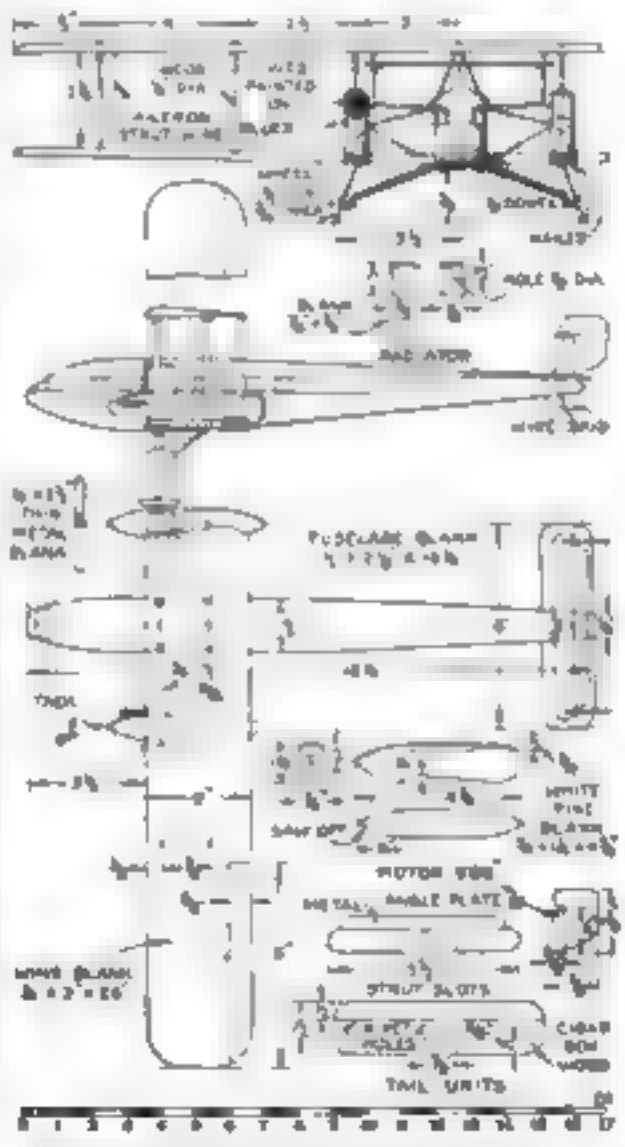


An easily made nonflying model of a twin-motor transport plane. See photo on page 99

By DONALD W. CLARK

IMPRESSIVE in size and unusually interesting in design, the Curtiss Condor twenty-one place transport biplane is an excellent subject for the airplane model builder. A realistic and reasonably accurate model of this giant twin-motor plane can be built without difficulty.

The principal parts are cut from soft white pine. A few scraps of this wood



Working drawings of the model, which has a 26-in. wing span and a 16¼-in. fuselage

together with some ⅛-in. round sticks, a cigar box, odds and ends of thin aluminum or other sheet metal, a few brads, and a small quantity of chrome yellow, lemon yellow, orange, and black enamel or lacquer are the only materials needed.

Carve the fuselage from a block 1½ by 2⅛ by 16¼ in. and round off the front and rear ends to the proper shape. Drill holes for the wing pins or dowels and one at the rear for the tail skid.

Cut the upper wing from a pine blank ¼ by 3 by 26 in. and the lower wing from a blank ¼ by 3 by 24½ in., sawing the latter in two.

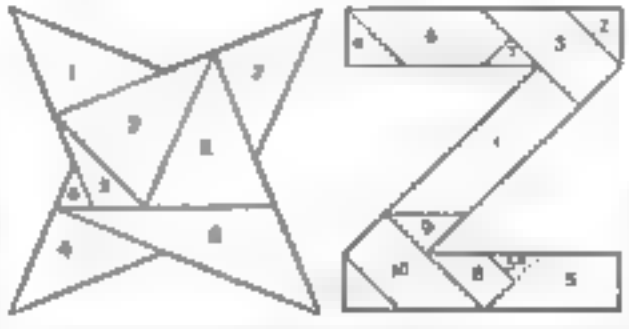
The stabilizer should be made from cigar box wood and nailed to the fuselage. The auxiliary stabilizer and rudder are of thin metal riveted together as shown. The motor "eggs," radiators, and wheels are all made of wood. Set short lengths of ⅛ in. diameter wire into the motor "eggs" to represent the exhaust pipes. The landing gear and the wing brace struts can be cut from thin aluminum and nailed in place. The heavier struts are strips ½ in. wide; the lighter ones, ⅜ in. wide.

Do not slight the finishing because much of the smartness of the model depends upon the care taken in the painting. The colors suggested are as follows: For wings and horizontal tail, chrome yellow; for fuselage and rudders, lemon yellow; for top of fuselage, motor "eggs," wheels, and struts, orange; for propeller, tail skid and tires, black.

LAST CALL FOR SHIP MODEL CONTEST

IF YOU are interested in making ship models, do not overlook the contest being conducted by POPULAR SCIENCE MONTHLY for ship models built in bottles. The method of constructing this type of model was explained by Capt. E. Armitage McCann in an article beginning on page 71 of the August, 1930, issue, and full details of the contest were published on page 99 of the same issue. There is, however, still time to enter the contest, for it does not close until October 15, 1930. All entries must reach the Ship Model Contest Editor on or before that date.

PUZZLE SOLUTIONS



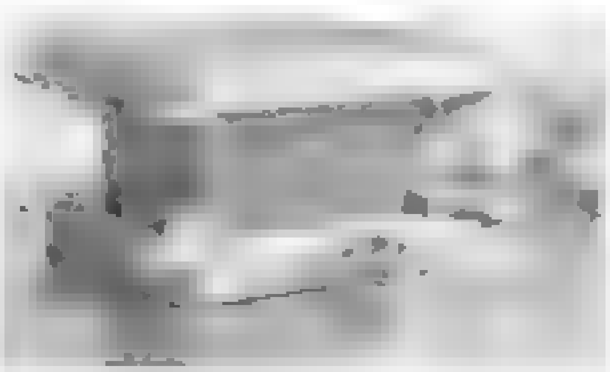
How to assemble the block puzzles described in the September issue of POPULAR SCIENCE MONTHLY

DID you succeed in solving the four-point star and letter Z block puzzles published last month (P.S.M., Sept. '30, p. 114)? If so, your solutions should check with the diagrams above.

CLAMP AIDS IN GLUING SMALL FANCY BOXES

IN USING fancy cabinet woods to make small ornamental boxes with mitered corners, it is sometimes difficult to glue up the sides square, especially if the box is too small for any of the regular clamps available. The problem can be overcome, however, by the simple method illustrated, which was used for a decorative box made of ... rosewood.

Two pieces of smooth ... pine were cut about 2 in. larger than the outside measurements of the box. On these pieces lines were squared to the exact dimensions of the box. Eight small pieces of ½-in. hardwood then were cut as



A small box held in a clamp consisting of two boards and eight notched corner blocks.

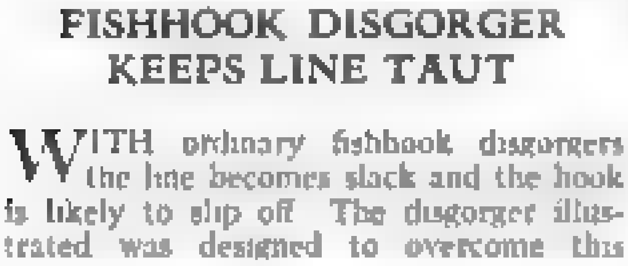
shown, and a deep notch of a little less than 90° was sawn in one end of each. The edges of the notches were rounded.

Screws were driven through the small pieces and started obliquely in the pine just outside each corner of the rectangle to be occupied by the box. Then, when the sides of the box were in place, pressure was exerted on the corners by tightening the screws.

If it is wished to insert brads for strength, the whole jig can be placed in the vise and the nailing done before loosening the screws.—Hugh M. Anderson.

FISHHOOK DISGORGER KEEPS LINE TAUT

WITH ordinary fishhook disgorgers the line becomes slack and the hook is likely to slip off. The disgorger illustrated was designed to overcome this



The feature of this fishhook disgorger is a post around which the line ... wound

difficulty. After the hook is caught in the V-opening, the line is brought back and wound three or four times around the post *A* and then brought back to the handle. Pushing down the handle then loosens the hook so that it comes out easily as the line is held fast. Although I brazed the V-opening, the joint can be made by wrapping fine brass or copper wire around the two parts and soft soldering them.—G. P. Sharp

Toy Table and Chairs Built Like "Grown-Up" Furniture

They're bound to please any small child

By HARVEY E. GREENE

FOR the handy man who has a home workshop and a wood turning lathe, the accompanying designs for a child's table and chairs will provide a diverting and somewhat unusual project

The writer used cypress for all but the table and chair legs and the chair back spindles, which are of fir, a little harder and tougher wood

The ⅝ in. thick table top (Fig. 1) is made by gluing two or three pieces together with doweled butt joints. Square up the ends and long edges and lay out the corner curves with the aid of a heavy paper or cardboard pattern. Saw the curves with a coping saw, or better still, with a jig or band saw, keeping 1/32 in. outside of the pencil marks. Smooth up the curves with cabinet rasps or with a motor-driven sanding disk and drum.

Next make the rails, which are of ¾ in. stock. The best way to determine the angle for the ends of these pieces is to prepare a full size layout and then set your bevel square to correspond. Mark the ends of the rails and saw carefully Also plane off the top edge of these pieces to the same slant to provide a good base for the top.

Bore ¾-in. holes from the underedge of the rails, as shown at *A*, Fig. 1, to within ¾ in. of the top edge for the screws that hold the top. Drill on through with a 5/16-in. bit for the shank of the screw. Small angle irons may be used to fasten the top, if you prefer

On the inside faces of the rails lay out and saw the notches for the corner blocks

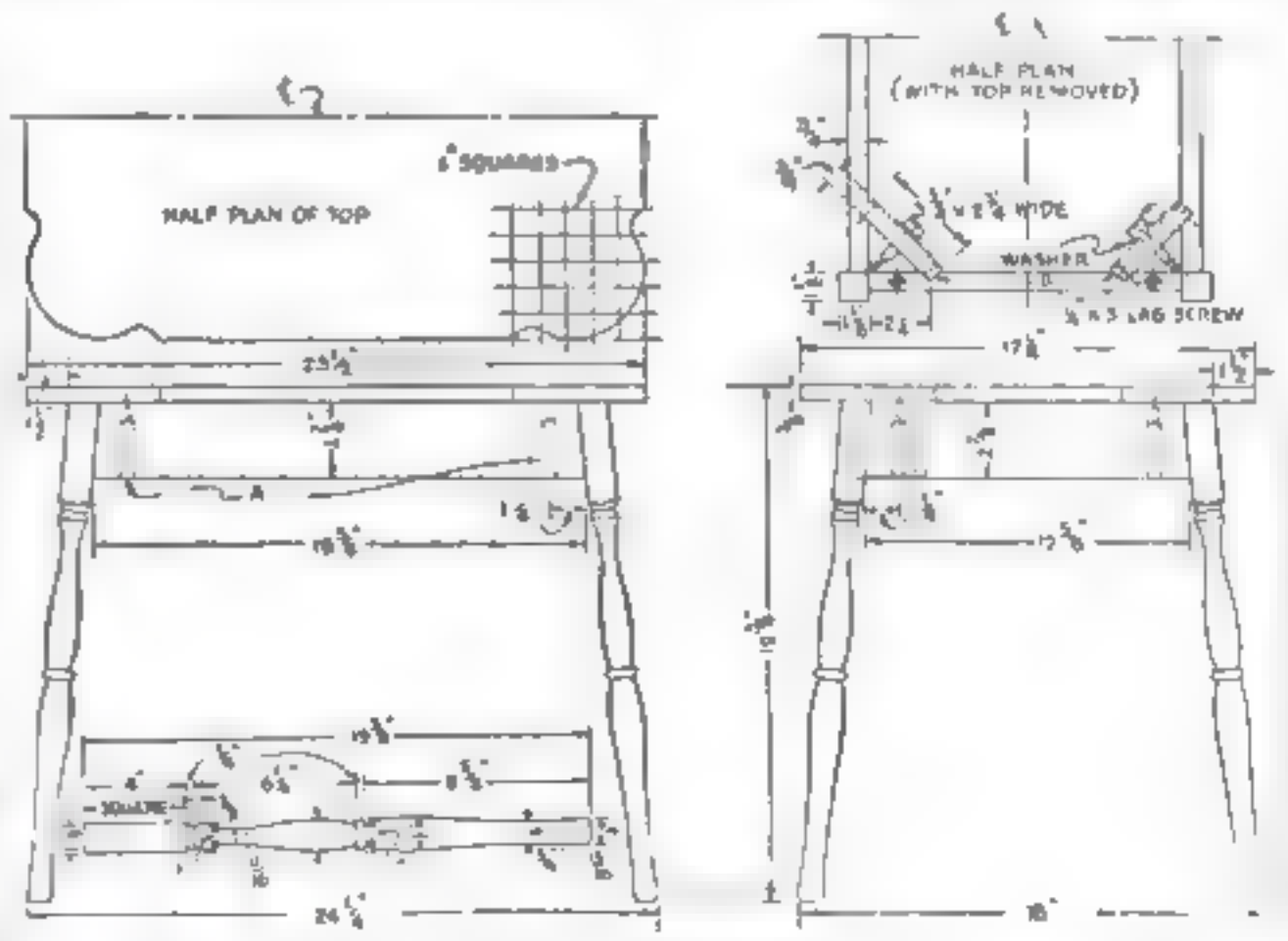


Fig. 1. Side and end elevations of the child's table and two plan views, one showing half the top with squares for laying out the corners, and the other, how the frame is assembled

as shown at *B*. These must run at the same angle as the rail ends. The corner blocks are simply ¾ by 2¼ by 3¼ in hardwood, with square edges on the ends and a 5/16-in. hole in the center of each for the lag screw

Turn the legs and sandpaper them thoroughly. Your work will be much easier if you make full size drawings of all the turned parts before you start the turning. The outside corner of the top of the

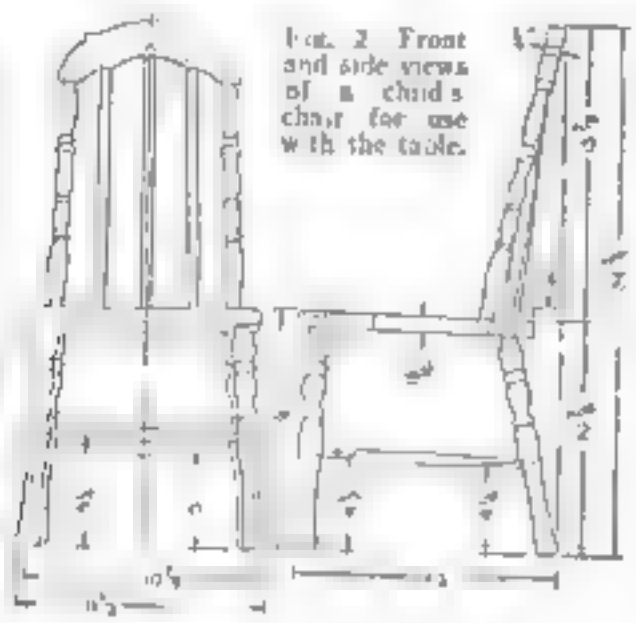


Fig. 2 Front and side views of a child's chair for use with the table.

leg will have to be cut off at the same angle as the top edge of the rails

Now glue and nail the corner blocks in place and mark the position of the lag screw holes in the legs. Drill the holes and fasten the legs, using a good grade of glue. This type of joint was used because of its simplicity and sturdiness, but a mortise and tenon joint or a doweled butt joint could be substituted. The top is fastened to the completed framework with 1¼-in. screws.

Before starting the chairs (Fig. 2), prepare full size "skeleton" layouts to give the angles of the legs with the seat, of the back spindles with the seat, and of the rungs with the legs.

The seat should be cut from one solid piece of 13/16-in. stock. After smoothing and sandpapering the curves, bore the holes for the back spindles, fillers and legs. To do this, first clamp the seat flat on your bench with a hand screw or a clamp. It is helpful to have two bevel squares, because each piece fitting into the seat except the center back filler, has a double angle, but you can cut a wooden template for one of the angles and use a

LIST OF MATERIALS

Two Chairs for Children

No.	T.	W.	L.	Parts
2	13/16	10½	11	SEATS
4	1	1	12½	BACK SPINDLES
6	¾	¾	13½	BACK FILLERS
8	1⅛	1¼	10¾	LEGS
8	¾	¾	dowel	RUNGS
2	¾	3	8½	BACK SLATS

Child's Table

1	⅝	17¼	23½	TOP
2	¾	2⅛	18¾	SIDE RAILS
2	¾	2⅛	12⅝	END RAILS
4	1 ⅛	1⅛	19⅛	LEGS
4	¾	2¾	3¼	CORNER BLOCKS
4	¼"	Dia.	3	LAG SCREWS

All dimensions are in inches.

bevel square for gaging the other angle.

After marking the location of the holes on the underside as shown dotted in Fig. 3, start the bit into the wood and bring the bevel squares to within ⅛ in. of the bit. If possible, have someone hold the squares in place while you bore the holes.

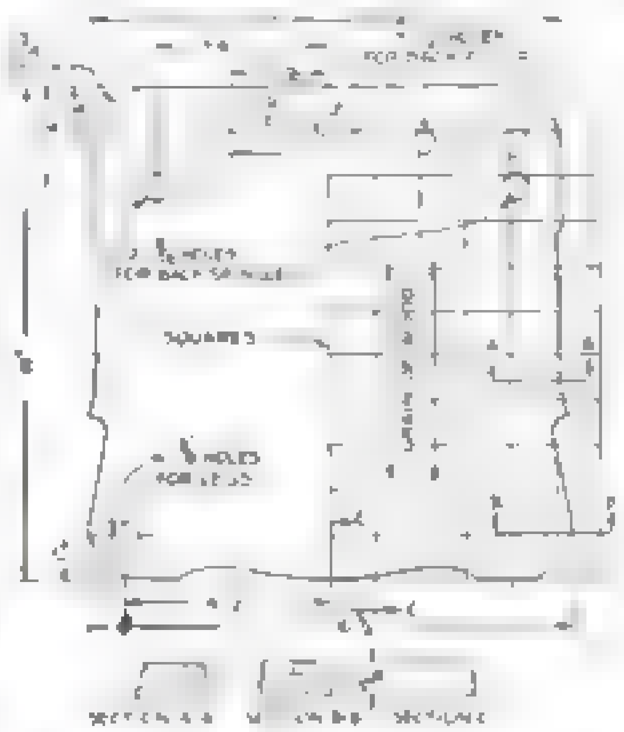


Fig. 3. Top view of the seat, half of it overlaid with 1-in. squares for enlargement

Be careful, too, that the screw of the bit does not break through the top of the seat. If you have a ¾-in. Forstner type bit, there is less danger, as this bit does not have a center screw.

Locate the holes on the top of the seat for the back spindles and fillers and bore them in the same way.

The back slat (Fig. 4) is made of straight grained ½-in. stock. The writer followed a rather peculiar method of construction because of past sad experience in boring any holes close to the edge of softwood pieces. He got out two pieces

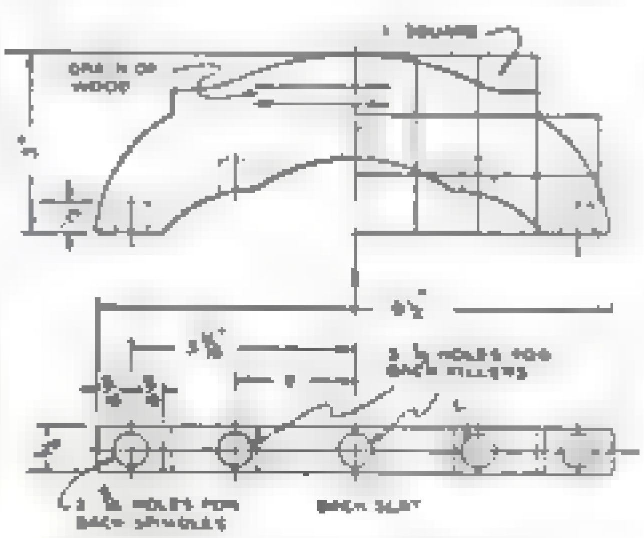


Fig. 4. Face and underedge of the back slat. Bore the holes, then do the sawing.

3⅛ by 10½ in., or 2 in. longer than really needed, and planed both sides and one edge square. From a cardboard pattern the shape was laid out on the wood leaving enough stock beyond the ends to eliminate the danger of the wood's splitting when the holes were bored.

Locate the holes as shown for the back spindle and fillers, and clamp the back slat in the vise with the square edge up and parallel with the bench top. Set the bevel squares to the angles indicated on your layout of angles; then bore the holes. The curves can now be cut out and smoothed up, and the piece sandpapered.

Turn the legs, back spindles, fillers and rungs as shown in Fig. 5. Be careful to caliper the ends of these pieces accurately, for the sturdiness of the chairs depends on the joints. Cut the pieces an inch or two longer than the finished dimensions so there will be no danger of striking the revolving spurs. Sandpaper thoroughly.

Clamp the legs one at a time in the vise and, using a bevel square set at the

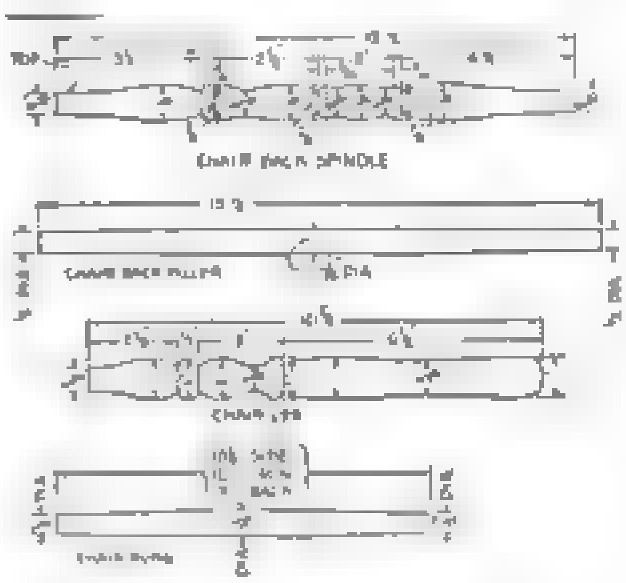


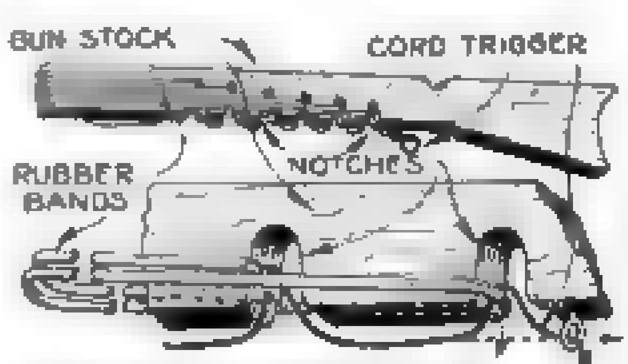
Fig. 5. Details of spindles and fillers for back of chair and the chair legs and rungs.

required angle, bore the ½-in. holes for the rungs.

Assemble the chair with "dry" joints to see if all the pieces are the correct length and the angles are as they should be. The joints should be a snug force fit, although not so tight as to require hammering. If the pieces go together accurately, take the chair apart and glue the rungs in the legs first. Next, glue the legs in the seat. After the glue has had time to set, glue the back spindles and fillers into the back slat and then into the seat. Remove all surplus glue with a chisel or scraper.

The finish of this little set is, of course, a matter of personal choice. A stain, shellac, and varnish finish is beautiful and very durable, but as an alternative you may use quick-drying lacquer or enamel.

REPEATING RIFLE SHOOTS RUBBER BANDS



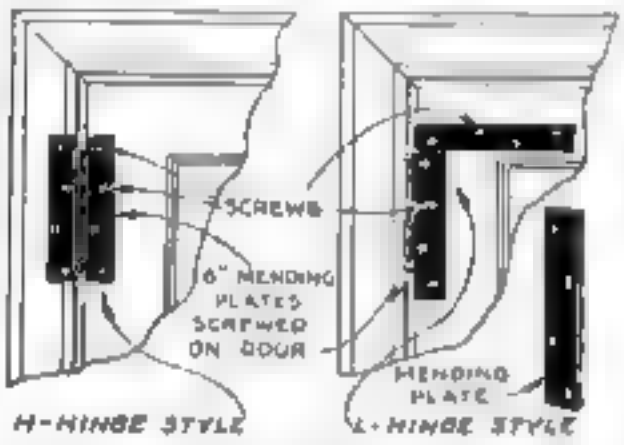
As the cord trigger is pulled, the rubber bands are released in succession.

SHOOTING rubber bands with surprising accuracy, this gun can be whittled from a stick of soft pine by any boy. The ammunition consists of rings cut from an old inner tube. They are stretched taut from muzzle to notches, one being placed in each notch in such a way that when the string is pulled the rubbers will be shot in succession, like bullets from a repeating rifle.—Anna C. Jones.

IMITATING WROUGHT IRON COLONIAL HARDWARE

RUSTY, tarnished, or stained door knobs and hinges, escutcheons, sash lifts, and sash fasteners detract much from the neatness and freshness of a home. Since the inside hardware in the majority of moderately priced homes is steel with a thin plating of brass or bronze, the problem of keeping it looking well is not easy to solve, for in only a few years it usually tarnishes, rusts, and becomes unsightly.

One of the easiest ways to refinish the hardware is to paint it to look like Colonial wrought iron. The village blacksmith in the old days had to hammer out all the door latches and L-hinges by hand, and



How common steel mending plates, enameled black, are used to imitate old hinges.

what is left of this hardware is highly prized and still adds much to the attractiveness of old New England homes.

Obtain a half-pint can of flat black metal enamel, a sheet of fine emery paper, and a camel's hair brush. Rub down the surface of the hardware you wish to renovate until it is clean and smooth; then apply at least two coats of the enamel to produce a durable surface. You will find these spots of black in the home are a relief from the riot of color which is characteristic of interior decoration at the present time.

If you wish to heighten the Colonial effect, purchase at any hardware store a supply of steel mending plates and fasten them to the doors against the hinges as illustrated. Plain wood screws may be used, or you can obtain heavy upholsterers' tacks with antique-finished heads. With these strips of metal properly applied, one can get the general effect of Colonial hinges.—J. Rogers Ullrich.

FILM OF OIL CORRECTS GRINDING ERRORS

IN USING the surface grinder on work that must be extremely accurate as to parallelism or with one surface precisely at right angles to another, difficulty is often experienced in overcoming an error too small to be corrected by inserting a piece of tissue paper between the work and its supporting angle-plate, chuck, or other fixture. This error may be eliminated by putting a streak of oil on the work or fixture opposite the "high" side. The slight film of oil will push the work away from its supporting surface approximately .00025 in.—W. W. Lyon.

KEEPING WOODEN VISE JAWS PARALLEL

BECAUSE of its low cost and large size, the old-fashioned carpenter's vise is still frequently installed on homemade woodworking benches. The vise screw, nut and handle can be purchased at any well-stocked hardware store, and the jaws may be made of any available hardwood.

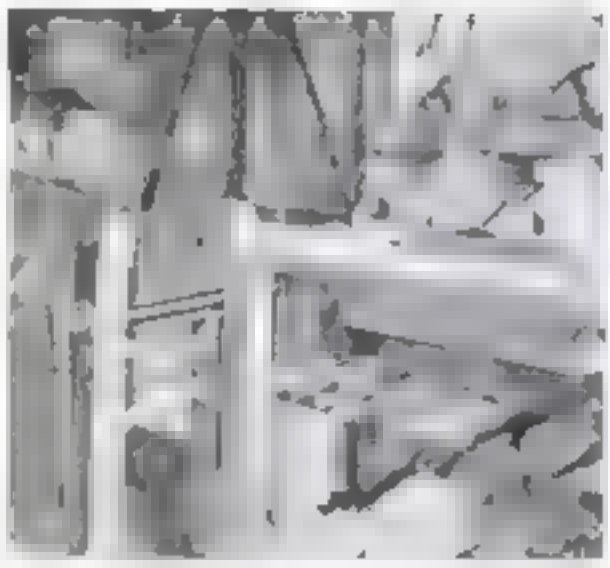
The most serious objection to this type of vise is the difficulty of keeping the jaws parallel. The common method is to use a strip of wood running through slots at the bottom end of both jaws and held with pins through a series of holes in the strip, but obviously this does not allow quick and accurate adjustment. A very much superior way is to install X-bars as shown, for they insure automatic adjustment and keep the jaws parallel.

The jaws of a bench vise of this type should be of hardwood. Oak or hard maple from 2½ to 3 in. thick and from 4 to 5 in. wide is satisfactory. The back jaw should be perfectly plumb both ways and secured firmly at top and bottom. If the vise is placed at the extreme end of the bench and the jaws extend above the top of the bench about 3 in., it is possible to work easily on all sides.

The three ⅜ by 1 by 14 in. bars for the parallel adjustment may be handmade of iron or steel, but machined bars will be better and probably no more expensive. Their size and length may be varied from the dimensions given, but they must be exactly the same length, and the pin which connects them must be exactly central. The ends are rounded off to a radius of the width of the bars, and the holes for the pins at the upper ends must be centered in the radius.

The grooves in the face of the jaws should take the assembled bars with a slight allowance for play. The depth, which must be uniform throughout depends on the size of the pin and the depth from the face of the jaw at which it is fastened. In the vise illustrated the grooves are 13/16 in. deep and 1¼ in. wide. The rounded ends of the bars should lie against the bottom of the groove to take part of the thrust.

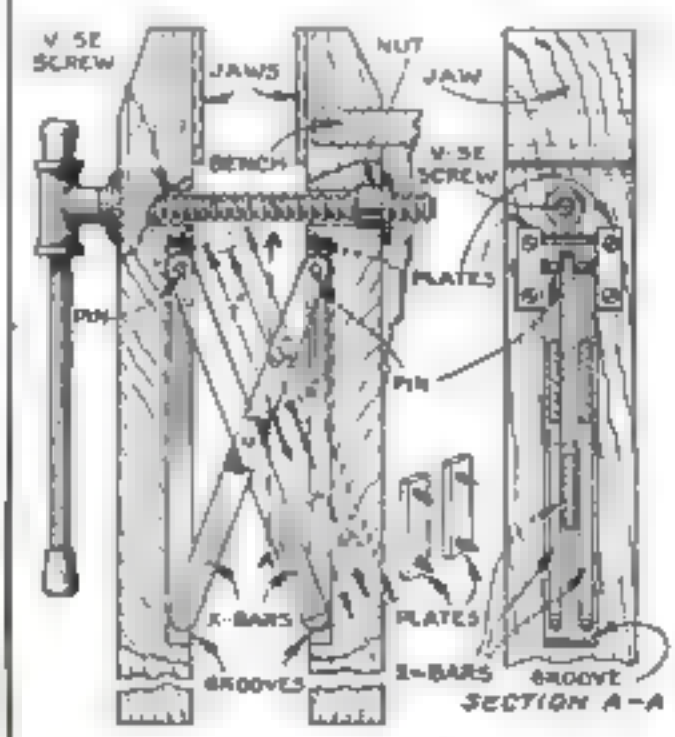
To avoid a deep groove, the pins may be let into the face of the jaws in a square hole or groove that is only deep enough to permit metal plates to be fastened over the ends of the pins and flush with the face of the jaws, as illustrated.



How a wooden bench vise can be improved so that the jaws always remain parallel

The two pins and the central rivet or machine bolt must be heavy. In the vise illustrated they are ¾ in. in diameter.

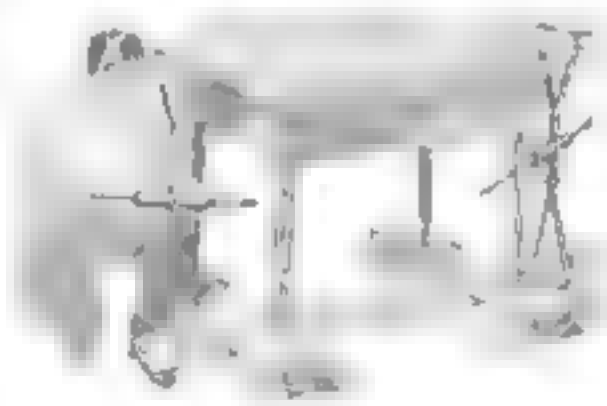
—HENRY GEORGE



The X-bars are pivoted at the top, the lower ends move freely in the grooves.

ROPE CLAMP FOR GLUING VENEERED FURNITURE

IN REGLUING veneer over the entire laminated top of a desk, the writer found it impracticable to take the piece apart, yet there were no clamps available large enough for the work. The problem was solved by the old turnbuckle princi-



Reglueing the veneered top of a valuable desk with ropes twisted like turnbuckles.

ple applied as illustrated. A short length of pipe was inserted between the ropes at each end for the purpose of allowing the twisting rod to be shifted back and forth as necessary to clear the desk legs, and when sufficient pressure had to be obtained, the rod was slipped through the pipe far enough to hold against the legs and prevent untwisting. No lower cribbing is needed for a job of this kind if it is possible to insert ringbolts in the floor.

Many pieces of blistered and warped veneering on large pieces of furniture can be repaired in this manner when more pressure is needed than can be ordinarily applied by piling on weights. To insure ample pressure at the center of the top surface, the plank which runs across should preferably be slightly bowed and should be placed with the convex face down.—L. W. HENDERSON

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, Popular Science Monthly offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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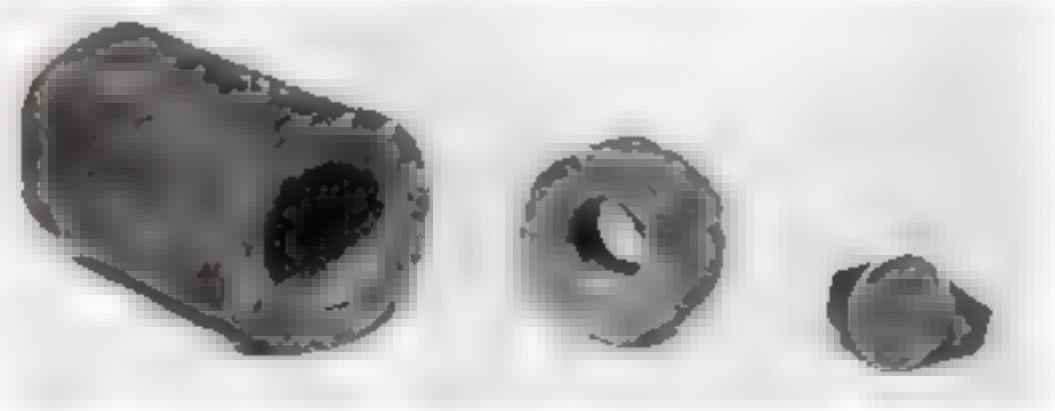
How to Cast a Signet Ring in a Cuttle Bone Mold



Left: Length of lead pipe from which pattern is cut. *Center:* The ring pattern cut to size and ready to be shaped. *Right:* The completed pattern.

By RAYMOND B. WALES

IF YOU are a reasonably good whittler, you can make a gold or silver ring. But what connection is there between whittling and jewelry making?" you may ask.

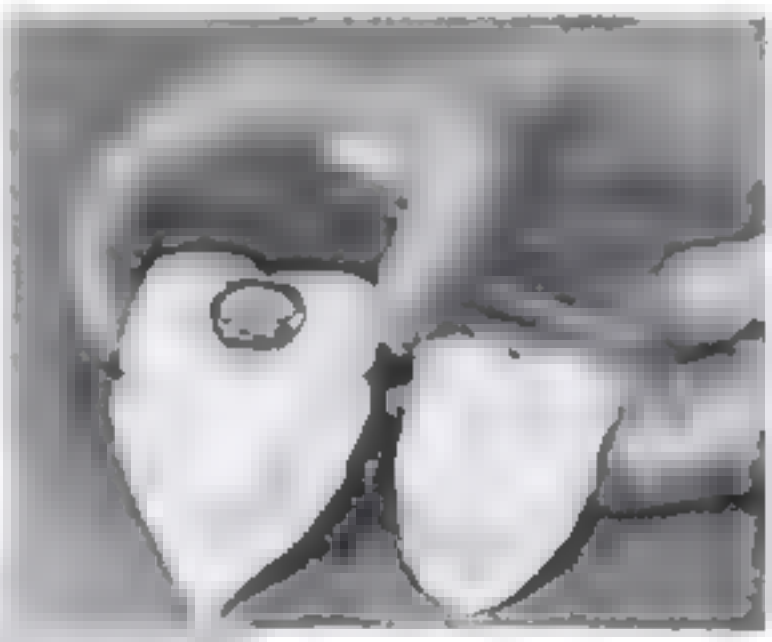
Simply this—your ring will be a casting made from a pattern which you will cut with a penknife from a short length of lead pipe. Whittling the pattern is the first and most important step.

Find a section of lead water pipe having a suitable inside dimension. Then choose a design for a signet type of ring and cut out a pattern as accurately as possible from the pipe.

The mold is formed of two cuttlefish bones such as are used in bird cages. Rub them against each other with their flat sides in contact until they fit perfectly flat surfaces. The lead pattern is pressed halfway into the soft flat face of one of the bones, and the other bone is pressed down upon it until the two bones touch. Marks are then made on the edges of the halves so that when they are taken apart and the pattern removed, they can be lined up again in their matched position.

A pouring "gate" or trough is scooped out at the top of the mold thus formed, and small channels are made with a knife edge to act as vents for the escaping gases which form when the metal is poured. The bones are wired together so that the two halves match and are placed in a can of sand. They are then ready for casting.

Gold or silver scrap, such as odd pieces of cuff links, stickpins, and old silver



[illegible] Pour [illegible] silver into the [illegible]

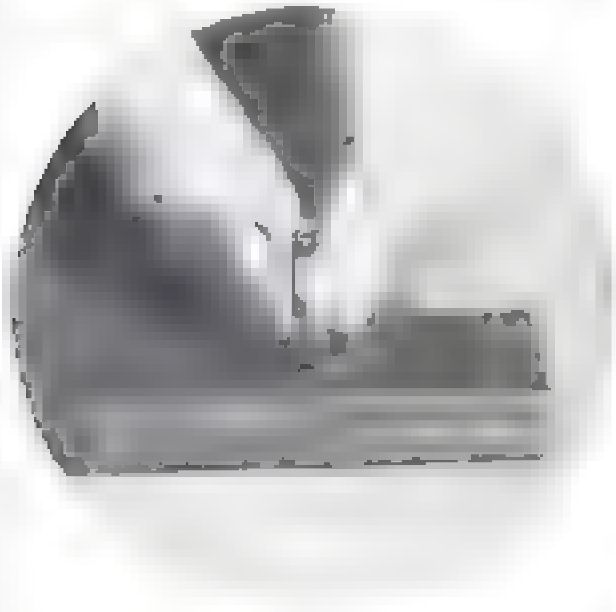
[illegible] the casting. Place the metal in a small sand crucible or even a porcelain evaporating dish such as is used by chemists.

For melting the metal it is necessary to have a burner equipped with an air blast, such as a blacksmith's forge which will produce a melting temperature. However the casting can be done by almost any local manufacturing jeweler at small expense, if you furnish the mold ready for pouring.

The casting is removed when cold. It will be found by examination that all of the minute "veins" of the cuttlefish bone are seen in the casting—an indication of the fidelity with which a cuttlefish mold brings out every detail. The mold should then be discarded, as it is good for only one casting.

The casting should now be smoothed

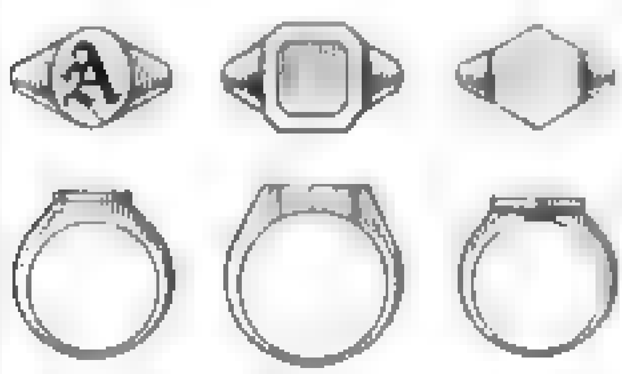
with small jeweler's files. A flat abrasive stone of fine grain is needed for facing the bed plate, or face, of the ring, and a round stone for "slicking up" the inside of the ring. A strip of emery cloth which has had virtually all of the emery rubbed from it by long usage will remove the ridges which are sometimes formed by the stones



The top face of the silver ring can be surfaced by rubbing it on a tool sharpening stone.

used to remove the minute file marks. An application of commercial silver polish will then complete the finish

The initialing can best be done by a professional engraver, who will also give your handmade ring a final buffing and polishing on his motor-driven wheel



Three [illegible] rings. The [illegible] can be done by a professional engraver

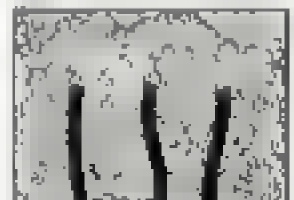
BUILDING FURNITURE TO SUIT A CHILD

MANY pieces of small furniture, playhouses, and other equipment made for children in the home workshop look as gawky as a day-old calf. The reason for this is usually a lack of proportion, and the way to overcome it is to work to a definite scale

For example, in starting to make a dressing table for an 8-year-old girl, I was stumped as to dimensions until I hit on the idea of comparing the height of the child with that of an adult. I found that my daughter was exactly 66 percent of the height of her mother—a higher percentage than the average man would guess. The mother's dressing table was measured and all the dimensions were scaled down to 66 percent in drawing the plans for the child's table, that is every 1 in. on the large piece equalled .66 in. on the smaller. The resulting piece of play furniture was in perfect proportion to the larger table and to its little owner.—L. W. HENDERSON

ORDINARY LATHER

[illegible]



COLGATE LATHER

[illegible]

Wiring Your Home Workshop for Light Machinery

By HAROLD P. STRAND

TODAY the home workshop enthusiast does not depend on slow hand methods for any work that can be done accurately and speedily on the small motor-driven machines now so popular. How convenient it is to rip a board into strips of the required width on the circular saw, and by the snap of a switch to have a buzzing planer ready to smooth and square up the surfaces and edges! Then we have our woodworking and metal turning lathes, our band and jig saws, possibly a power shaper, not to speak of our electric drill, upright bench drill, sander, emery grinder, and other machines, each with its own special mission to perform in labor saving. No wonder that mechanical America has turned to the power home workshop!

If care is taken to observe Code requirements, a home worker should have little difficulty in wiring his shop.

With the advent of these machines, the question of correctly planning the wiring to supply their individual motors is worth a little study. The sizes of the motors vary from 1/6 to ½ H.P., with perhaps ¼ H.P. as the average. One of this size will draw about 5 amperes from the circuit on alternating current. To the uninitiated we might add that this means a current equal to that drawn by five 100-watt lamps. This value differs, however, with the type and make of motor.

If the motor is wound for from 110-220 volts (that is, if it has four leads coming out), it can be used on the 220-volt line with better satisfaction, provided, of course, that you have an Edison three-wire system in your house. In this case, the motor will draw but half the current, or 2.5 amperes. The power companies much prefer this arrangement as to throw a string of motors on the lighting line causes a dip in the light in both your own and your neighbors' houses, and may give some cause for complaint. On the other hand, if the three-wire system is not available, the ordinary two-wire system must be made to answer.

Figure 2 shows how a separate cut-out cabinet is connected to the lighting cabinet, the two outside wires of the lighting cabinet supply being used for the 220-volt operation of the motors. The cut-out blocks are the cartridge type, 220-volt, 30-ampere, using a fuse of about 10-ampere size for the ¼ H.P. motors. The circuits for the motors may be either separate or grouped together under one or more sets of fuses, provided the Code requirements are observed—that not more than 1,320 watts total be connected and no motor of over a 6-ampere rating be included in a circuit. The advantage of having separate circuits is that if trouble develops in one motor or its cord, others are not tied up with the blowing of the fuses, also the use of a pilot lamp for each circuit is possible as

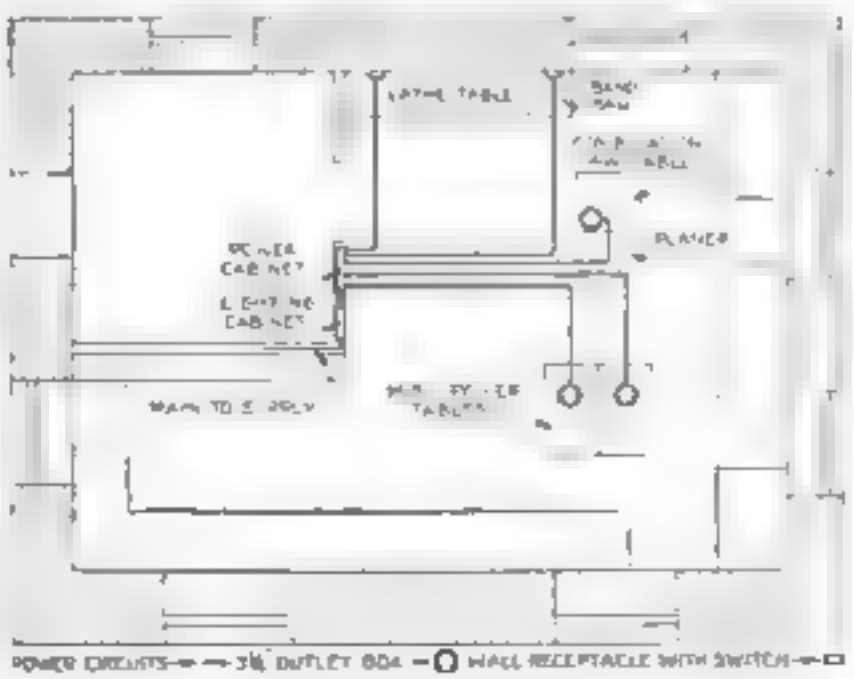


Fig. 1. Layout for power wiring in the larger of the shops described in a previous issue (P. S. M., Sept. 30, p. 95)

was suggested for the lighting lines in a previous article (P.S.M., Sept. '30, p. 98).

For straight 110-volt lighting and power service the cut-out blocks for both may be installed in the same cabinet, if you wish, or a separate cabinet can be provided, keeping the power blocks independent. In the case where your supply is 110-220 volts, but your motors are wound only for 110 volts (that is, each motor has but two leads coming out), the higher voltage unfortunately cannot be used for their operation, and then they must be divided up evenly and connected half on each side of the neutral, by using the

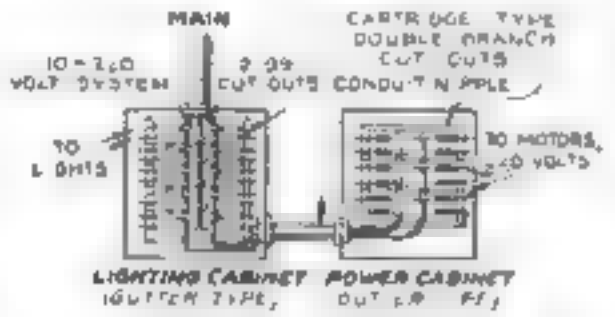


Fig. 2. Layout for lighting and power-cabinet wiring the supply for power being 220 volts

"2199"-type cut-out blocks in the cabinet, thereby providing a balanced system of distribution.

The size of the mains, which must feed both lighting and power, is a point to be carefully figured out. To do this, one must add up the wattages of the lamps in the fixtures and divide this sum by 110 or the voltage which gives the number of amperes used by the lamps. Next, take the readings in amperes from the name plates of the motors, add them up, and then add this sum to the lighting amperes, giving the total load. Now, at least 25 percent extra (or overload) is required for added starting current on the motors, but I recommend that at least 50 percent be allowed to provide for additional equipment. By referring to the table on page 118, find the size wire necessary for the mains. For example, supposing that you have ten 150-watt lamps, making 1 500 watts total, and the total of the motor readings is 30 amperes. Dividing 1 500 watts by 110 volts gives 13.6 amperes, which the lamps consume. Add 30 amperes for the motors and you have 43.6 amperes for the total load. Take 50 percent of this, 21 8, and add it to 43 6, making the grand total of 65.4 amperes. The table gives No. 4 wire at 70 amperes as the nearest size This, therefore, would be the correct size for the mains supplying both lighting and power, with 50 percent allowance for starting current and future additions on a two-wire system.

In 110-volt operation on a three-w re

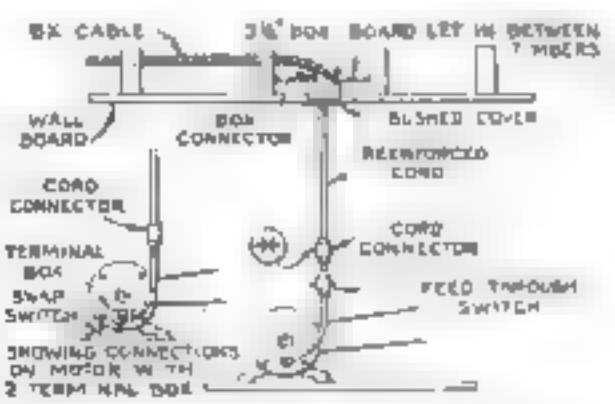


Fig. 3. How a small motor, which is away from the wall, is supplied by a drop cord.

system, this load would be divided and carried on each side of a neutral wire its mains being only No. 8 size (half of 6 × 4 equals 32 7, making a No. 8 wire carrying 35 amperes sufficient)

From the cut-out cabinet, which is cut in flush with the wall, BX cables are run for the individual circuits. If these are placed along the wall, the cable terminates in a receptacle box containing a duplex receptacle and a toggle switch to control the motor (see Fig. 4); this arrangement saves pulling out the cord after each time that the motor is used. A duplex receptacle is suggested because it offers a change of connection, thereby prolonging the life of the receptacles.

For locations in the center of the floor a 3¼-in. junction box with a bushed cover is fastened directly over the motor. The circuit cable ends here and a reenforced drop cord is connected. On the end of

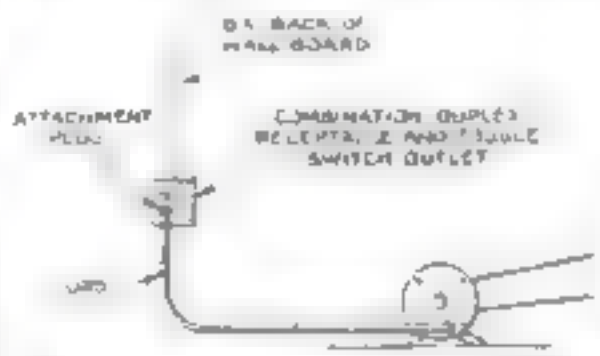


Fig. 4. A duplex receptacle allows a change of connection, which tends to prolong its life

the cord at a suitable height, a "cord connector" is placed, which allows the motor to be connected or disconnected at will. This cord may also have a "through-cord" switch to control the motor; or if convenient, a surface type of snap or toggle switch may be mounted on the motor or the machine, a preferable method. In Fig. 3 is shown the machine station in the center of the floor area, while in Fig. 4 is illustrated a typical wall installation

Figure 1 is a layout for wiring the motors in the larger of the two shops taken as an example in the preceding article on lighting problems. Here there are five circuits, one for each motor. The BX is run parallel to the beams where possible and attached with small pipe straps sold for the purpose. When the cable must be carried across the timbers, it will be necessary to bore holes or make notches to allow it to pass without forming an obstruction for the wall board that is to be used to line the basement. Securely attach the trimmed ends of the cable to the boxes with either the approved clamps (if the boxes have them) or with box connectors. Use gas fitter's pliers on the latter to turn the check nuts up tight. All boxes where the wall board is used must be set back so they will come flush with the finished surface

WHEN all wiring is installed, but before the wall board ceiling and walls are put on, it is a good plan to call in the local electrical inspector to make sure that everything is safe and in accordance with the National Electrical Code and the local building ordinances. Take no chances, and if in any doubt at any stage of the work, consult a professional electrician or the electrical inspector

Finally, the wall board is put up in the usual manner and painted white, and the receptacles and switches are set in place

For a shop in which much electrical work is to be done, I suggest double wiring for the bench receptacles, so that both alternating and direct current will be available for testing and other purposes. The receptacles may be painted different colors to distinguish them. Whichever type of current is not supplied by the power company may be obtained from a small motor-generator set. Even if this double wiring is not needed at present, it might be well to install the wiring for future needs while the timbers are open

Another idea, while the wiring is being done, is to run the necessary wires for a private telephone from the shop to an upstairs room.

In a following article, Mr. Strand will offer some suggestions on the care of small motors

Safe Carrying Capacities of Copper Wires with Rubber Insulation

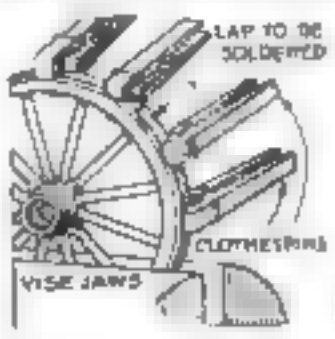
From the 1930 National Electrical Code

Gage No.	Diameter of Solid Wires in Mils	Area in Circular Mils	With Rubber Insulation Amperes
14	64.0	4,107	15
12	80.8	6,530	20
10	101.9	10,380	25
8	128.5	16,510	35
6	162.0	26,250	50
5	181.9	33,100	55
4	204.3	41,740	70
3	229.4	52,630	80
2	257.6	66,370	90
1	289.3	83,690	100
0	325	105,500	125
00	364.8	133,100	150
000	409.6	167,800	175

1 Mil = 0.001 inch.

CLOTHESPINS USEFUL IN COACH MODEL MAKING

IN BUILDING the POPULAR SCIENCE MONTHLY *Diamond Tally-Ho* stagecoach model (Blueprints 115, 116, and 117 in the list on page 103), I found that small spring clothespins were useful in holding the tires on the wheels while the joints were being soldered. The clothespins were placed between the spokes of the wheels as illustrated. This method allows the use of a vise and gives a better view of the soldering to be done



The pins hold the rim in place for soldering.

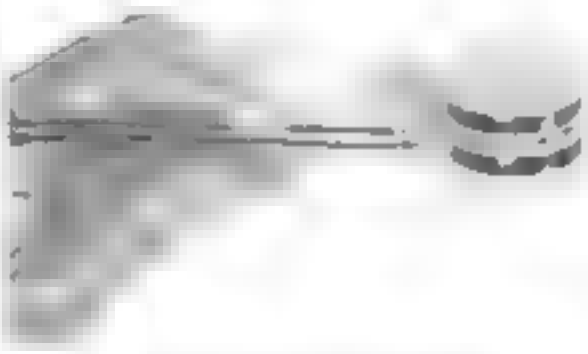
Clothespins are handy for many other clamping jobs in model making, and if necessary their jaws can be cut narrower or shaped to suit especially small, irregular parts.—J. M. NEAL, JR.

Trap for Poisoning Small Red Ants

THE latest method of exterminating common red ants is to use an ant trap made from an ordinary pill box. Anyone can make one of these traps in less time than it takes to read this article Remove the top of the box, cut four square holes in the inner collar, pour a thin layer of hot paraffin inside the box to make it water-tight, and the job is done

When filled with poison bait, the trap breaks up colonies of little red ants in short order.

If you have bacon rind available, cut it into small bits and work in some tartar emetic. This makes a good bait, and has



Trap for common red ants made from pasteboard pill box Poisoned bait is placed inside.

the advantage of allowing the ants to carry it off to their nests. In this way one ant may carry poison to 100

A bait which has given good results is made by dissolving 2 oz. of sugar in a pint of water and adding ¼ oz. of tartar emetic. Another bait, recommended by entomologists of the U. S. Department of Agriculture, who invented the trap, is made by mixing 1 pt of water, 1 lb. of sugar, 3 oz. of honey, and 27 grains of thallium sulphate. Heat almost to the boiling point but do not inhale fumes given off as they are poisonous. Fill the pill box about half full of small bits of blotting paper and pour the poisoned syrup over them It might be a good plan to have a druggist prepare the last named bait, since thallium sulphate is a powerful poison

With a half dozen pill-box ant traps colonies of red ants can be destroyed in a few days. When in use, the top of the box is placed partially on, as shown in illustration. When not in use, the top may be pushed all the way down

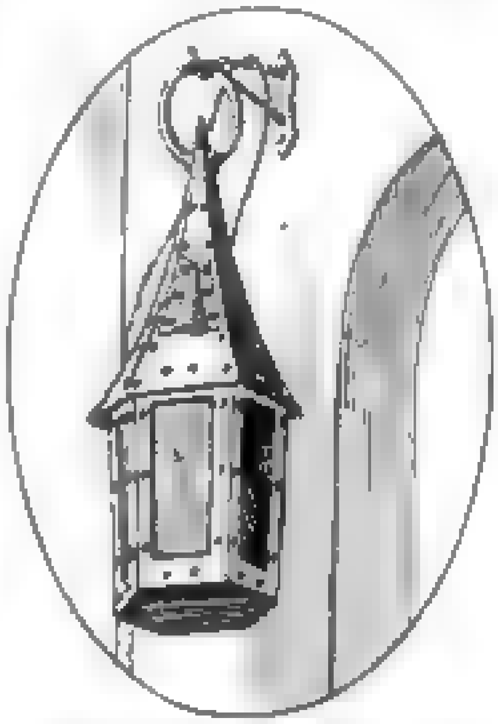
These traps can be left anywhere about the house, since the tops prevent pets getting the poison (except dogs which have a habit of chewing up such small articles), but keep them out of reach of small children.—E. G. MOORE

AN EXCELLENT mixture for cleaning and polishing nickel or chromium can be made from ordinary lampblack and alcohol Moisten a soft rag or a wad of absorbent cotton in the alcohol, press it into the lampblack, and rub the metal briskly The mixture, which dries almost instantly can be wiped off with another wad of cotton. While this polish cleans quickly and easily, it will not scratch or harm the surface.—CHARLES FELSTEAD.

Picturesque Electric Lantern Made for Sixty Cents

By MONTAGUE JONES

IN AN evening or two, anyone can make this realistic copy of a seventeenth century French lantern. The necessary materials are a small sheet of high-grade cardboard, a box of midget paper fasteners, gesso, a ring of some sort to form a handle, a small screw eye, gummed tape, a short length of wire, three fiber bushings like those used in electric light sockets, statuary bronze powder, bronzing liquid and green oxidizing liquid to give the finished article an antique patina. Some novelty lamp shade material or parchment is required for the windows, and a keyless socket, a threaded brass nipple and nut, the desired length of wire, and a plug. The cost amounts to about sixty cents.



Copy of an antique French lantern; the frame is of stiff cardboard

After cutting the six segments for the top, draw each one down over the edge of the table with one hand while pressing down the surface with the other hand; this is to give the cardboard the required curve. The edges of the triangles are now fastened with gummed tape, starting with the bottom and working towards the apex.

The body is cut out in one piece, scored about halfway through at the points indicated by dotted lines, bent to shape, and flattened out again. Then the windows and doorway are cut, after which the piece is folded and the lap glued. Cut out the bottom, score and bend the laps, and place the bottom in the lamp with the laps down using "rivets"—really paper fasteners—to hold it in position.

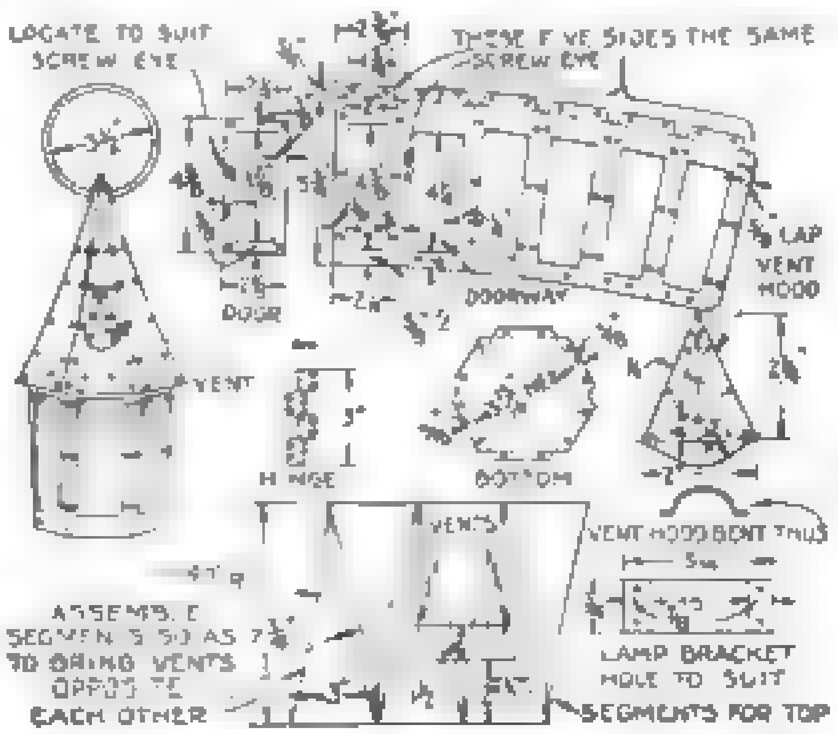
Now apply glue to the upper laps on the body and, standing the lantern on its base, press the top into place and insert the paper fasteners. For the two ventilator hoods, a lighter grade of cardboard may be used. Score and bend them; then glue and "rivet" them on. Set the fiber bushings in place, one for the electric cord and the other two for the handle.

Put the "rivets" in around the windows but do not open the prongs just now. Cut the door and make the hinge from four pieces of light cardboard folded around a wire and "riveted" in place. Locate the position of the hasp and put in the screw eye as well as the necessary "rivets" in the door. Form the handle and attach it to the top.

Give the exterior a good but slightly rough coat of gesso, a plastic mixture which can be purchased at art stores or made by mixing liquid glue and whiting with a very little linseed oil and varnish. When this is hard, apply a coat of the bronze. Allow this to dry and then paint or spray on the oxidizing fluid. Before this has dried, wipe over lightly with a rag, removing the fluid from the high points. Instead of bronze, you may use drop black and when dry lightly sand over the "rivets" until the bright brass shows through, or you may give the lantern a coat of aluminum and use a black wash instead of green.

Cut the material for the windows and punch the holes for the "rivets" after marking them off from the heads of the fasteners which are already in place. Put in the windows and clinch the fasteners.

Attach the plug and pass the other end of the wire through the bushing from the outside. Put the threaded brass nipple into the cardboard lamp bracket and screw on the nut. Wire the socket, glue the laps on the bracket, and work it into position inside the lamp, holding it in place until the glue has set firmly. Use as small a lamp as can be obtained.

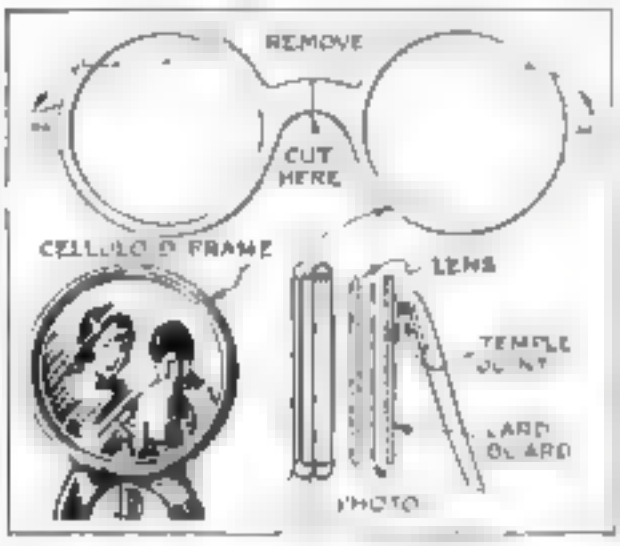


How to lay out, cut, and bend the cardboard parts for the framework. The top segments are joined with tape

MAKING OLD EYEGLASSES INTO PHOTO FRAMES

ATTRACTIVE and novel frames for small photographs can be made from discarded celluloid eyeglass frames.

Remove the lenses from the frame by placing the glasses in a bath of hot water Take off the side braces for the temple joints, smooth the rims, and cut the frame in half. Then remove all but one of the V-shaped ribs that originally held the



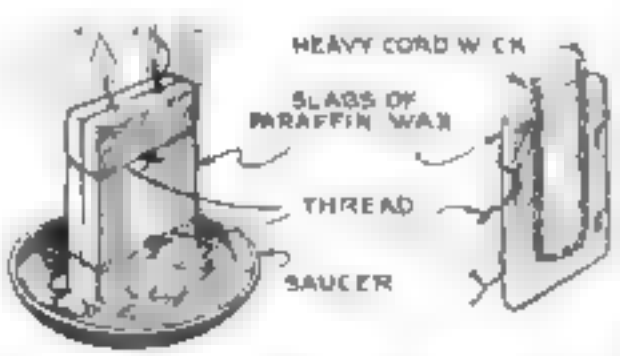
How a discarded celluloid eyeglass frame is converted into a miniature photo holder

lenses in place, as shown in the cross section view of the assembled photograph holder

Cement the two parts together with acetone and allow this to dry thoroughly In the meantime, prepare the cardboard back and rivet one of the temple joints to it. Cut one of the pieces that originally went over the ears to the proper length to provide a suitable third leg or rear support. Insert one of the lenses in the frame then the picture, and lastly the cardboard backing

To give the frame a high gloss, coat it with acetone and allow it to dry. Acetone can be obtained at any drug store or druggist supply house.—R. J. METZGER

HOMEMADE CANDLE FOR EMERGENCY USE



A candle that can be improvised quickly if storms interrupt the electric lighting service

WHEN violent electrical, wind, or sleet storms interrupt the power lines and plunge a locality into darkness, the supply of candles sometimes gives out, as it did recently in my town. It is, however, easy to make a substitute candle from two slabs of paraffin wax as illustrated. Place the improvised candle in a saucer or other shallow receptacle to catch the drip, and light both ends of the wick. The heat soon melts the wax sufficiently to stick the two halves together.—BARTON E. HANNA.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See Page 8.

Ways to Overcome Outside Painting Difficulties

MANY an amateur house painter is perplexed and discouraged because of defects which appear in work that he has done with the utmost care. When he asks for advice, he is often told that he must have used poor paint, whereas he probably bought ready-mixed paint of high quality—the best that his local dealer sells. The real reason for the unsatisfactory results obtained is more likely to be one of those described in the following questions and answers.

Paint blisters must be scraped off and all the spots sanded before repainting.

It does not do, of course, to minimize the importance of the quality of the paint. The most expert painter cannot obtain satisfactory results with a cheap grade of paint, any more than he can do good work with poor brushes.

What causes paint to blister and peel off?

This is one of the most common and most exasperating troubles experienced in outside painting. While there are different reasons for blistering and peeling, moisture is probably the cause of ninety percent of the cases.

In a new house the siding or clapboards may not be properly seasoned; the plastering may not have dried, the basement may be damp. In any of these events, the hot sun is likely to draw the moisture out through the siding, puffing the paint into blisters, many of which will break and peel off. Sometimes, when a house is painted in the fall, the moisture remains in the siding all winter, and blistering does not occur until the first hot days of the following summer. Always be sure the siding, plastering, and basement are thoroughly dry before painting is started.

In an old house it is, of course, equally as important that no moisture be present, but the sources of moisture are naturally somewhat different. Usually water gets

in behind window sills, door frames, or other open joints, or else it runs down from leaky eaves and downspouts. The source of the moisture should be located and repairs made, otherwise the trouble will continue.

In either old or new houses, moisture that has been left on the surface at the time of painting from a recent rain, heavy dew, or frost, will, of course, also cause blistering. Painting should, therefore, be done only when weather conditions are favorable.

What makes a house that has been painted several times with perfect results sometimes start peeling clear down to the wood?

The paint that is peeling off is the original priming coat, applied when the house was first painted for it is evident that the last coat is adhering tightly to the preceding coating. The cause is very likely to be some leaky place just recently started. Carefully examine the eaves and downspouts, and also see if there are any inside pipes which may be leaking. Water that is allowed to saturate the wood will force the paint away from the surface

If there are no leaky places, it must be that the priming coat never properly anchored itself to the wood. When first applied, the fresh oil in the paint film keeps it elastic, but through aging, more and more oil leaves the paint film until it finally becomes quite dry, lifeless and brittle, with a tendency to crack. Then when the house is repainted the additional weight of the new paint coating and the natural pull experienced by the drying of good fresh linseed oil, causes the previous coating to break away from the wood in places where the condition is the worst especially on the south and east sides of the house.

As to the remedy: First scrape off all loose paint with a wide putty knife, scraper or wire brush. Break any blisters with a putty knife and scrape off as far back as possible. Then coat over all these places with reliable high-grade paint, thinned liberally with linseed oil and turpentine to assist penetration deep into the wood. When the priming coat applied to these bad places has become thoroughly dry, follow with a two-coat job of painting over entire building. Take care that the first coat contains considerable turpentine but the second coat should, of course, be a full-gloss coat

If the peeled surface is in extremely bad condition, it may be necessary to burn off the old coating with a painter's blowtorch, but this should be done only by someone experienced in this work.

Why does paint sometimes become chalky and powdery, and what is the best method of repainting?

This condition, generally termed "chalking," is primarily due to the disappearance of oil from the paint film, leaving the pigment on the surface in dry powdery form without sufficient liquid to bind it together into a continuous film and anchor it to the surface. It is generally caused by insufficient oil and turpentine in the paint (particularly in the priming coat) to satisfy the absorption requirements of the more or less porous wood.

Where the surface is extremely chalky

Thinking in the right material

Hunting for every idea that can give their own company any advantage in this new competition of value-giving, more and more men and managers are analyzing, with the manufacturing mind every product in which Vulcanized Fibre or Phenolite is used. Picking ideas wherever they find them. And finding plenty

the powdery deposits should be taken off as far back as possible before repainting. One of the best methods of doing this is with an old stubby paintbrush that has been worn down so that the bristles are quite stiff. If this is not available, a medium stiff scrubbing brush will answer very well. The house should then be given two coats of paint in the usual way, but with an extra amount of oil and turpentine in the first coat.

What causes paint to wrinkle, and how can it be avoided?

The wrinkling of outside paint, which sometimes occurs soon after application, is almost invariably caused by piling on too thick and heavy a coat. House paint should be well brushed out to a uniformly even surface. There will be no wrinkling if this is done.

What makes streaks and spotted discolorations sometimes appear on a new house soon after painting?

They are generally caused by sap streaks and knots. The sun draws the pitch out of the knots and sappy places so that it comes through and discolors the paint. This can be prevented by coating all knots and sap streaks with pure shellac before the priming coat is applied. The shellac seals in the pitch. Where discolorations have occurred, these places should be sealed over with shellac, aluminum paint or other suitable sealer.

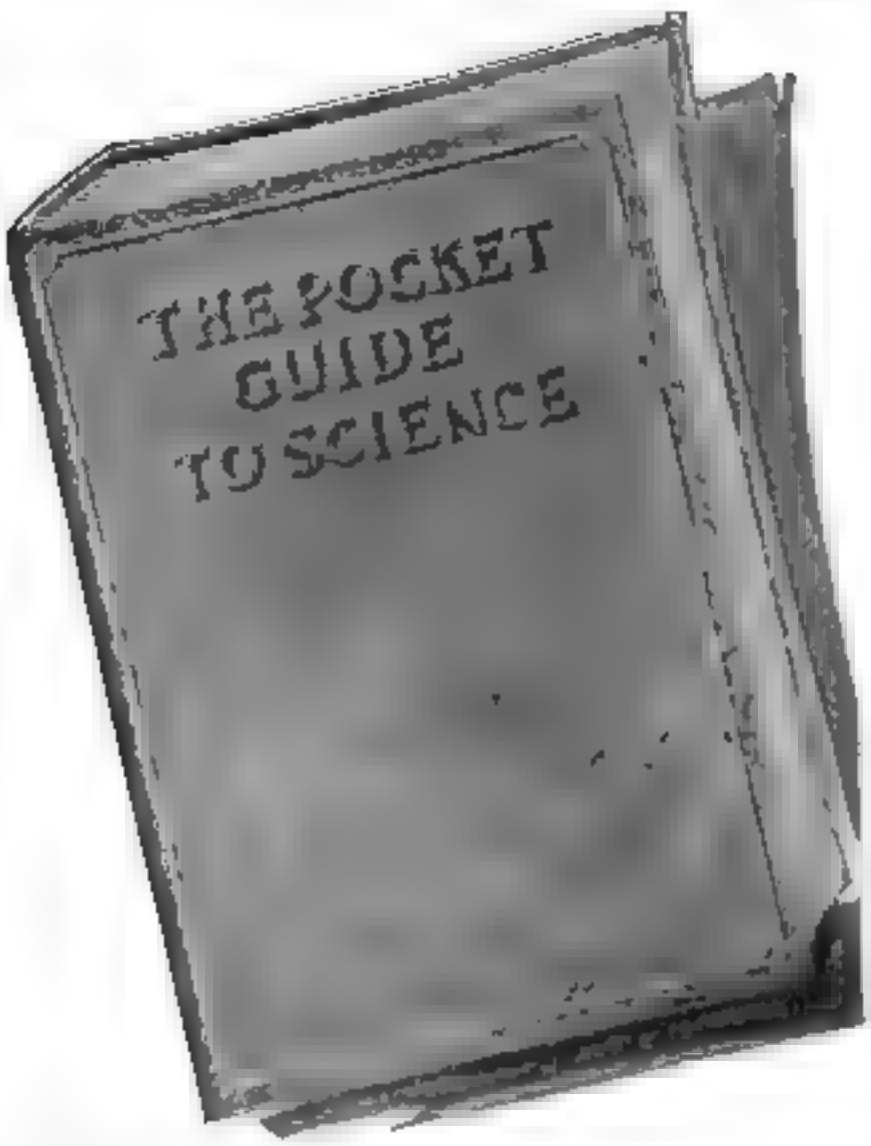
For thoroughly satisfactory results with a one-coat repaint job (and, preferably also with a two-coat job), an area a little larger than these sealed-in places should be painted over and allowed to dry before the first repainting coat over the entire building is applied.

How paint freezes, how can the surface be repainted?

Paint applied in cold weather is likely to freeze before it dries, causing the surface to become roughened and pitted. It is not only unattractive, but does not afford a tough, unbroken, protective coating to withstand the ravages of the weather, and it is also difficult to repaint. If repainting is done directly over the uneven surface it will continue to present a roughened appearance. To insure a good job, therefore, the old coating should be smoothed down.

This work is not so difficult if you will get some of the coarse-grit emery cloth used by floor finishers in their sanding machines. Some discarded pieces usually can be obtained from a floor finishing man in your locality, or the abrasive may be bought new from a floor finishers' supply house in one of the larger cities. Do not try to do the work with ordinary coarse sandpaper; it will be expensive and a never ending job. The coarse-grit emery is hard as flint, and with it the frozen nubs can be quickly cut down; indeed, you can get over the entire side of the house in a short time.

You will then have a good surface for repainting, which should be done in the usual way. Use a liberal amount of oil and turpentine in the first repainting coat, followed by a full-oil gloss finishing coat. This method will insure a perfectly satisfactory job.—BERTON ELLIOT



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Can memory be developed?
Why can't you skate on glass if it is smoother than ice?
How [illegible] work?
Why does [illegible]?
Can we see atoms with a microscope?
What are [illegible]?
Is [illegible] a form of matter?
What [illegible]?
How [illegible] the universe?
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An Easily Made Radio Bench

By W. L. DORRANCE

FOR the man with limited shop facilities, the radio bench illustrated is especially suited. There are no turned parts, and all of the joints can be easily and quickly made with hand tools.

Any attractive hardwood can be used in the construction of this neat little radio bench

Any attractively grained wood may be used in the construction of the bench. Red gum is excellent because of its finishing qualities. The posts, which are 1⅜ in. square, may be purchased already planed to the exact size, or they can be shaped in the shop. These should be about 1 in. longer than the dimensions given in Fig. 1 (on the following page) to allow for squaring. After squaring and cutting them to the exact length, mark the mortise positions on each (see Fig. 2). After the mortises have been cut, the ⅛-in. chamfer around the top of the legs may be formed. The corners are easily removed with a knife and a sharp plane.

The taper on the legs begins 13 in. from the bottom (Fig. 2). Mark ¼ in. in from each corner on the bottom of the legs and from these points run lines to where the taper will start. Sandpaper the legs thoroughly after they have been brought to shape with a plane.

Figure 3 shows the construction of the side and end rails. The tenons should be a little longer than the given dimensions and mitered off when being assembled, as shown in Fig. 4. These tenons should fit the mortises snugly, but should not be so

FIG. 1

The [illegible] no turned parts and all the joints can be made easily by hand

tight that they have to be driven in. After the tenons are cut, sandpaper the rails on the edges and outsides. Make a trial assembly and mark each piece.

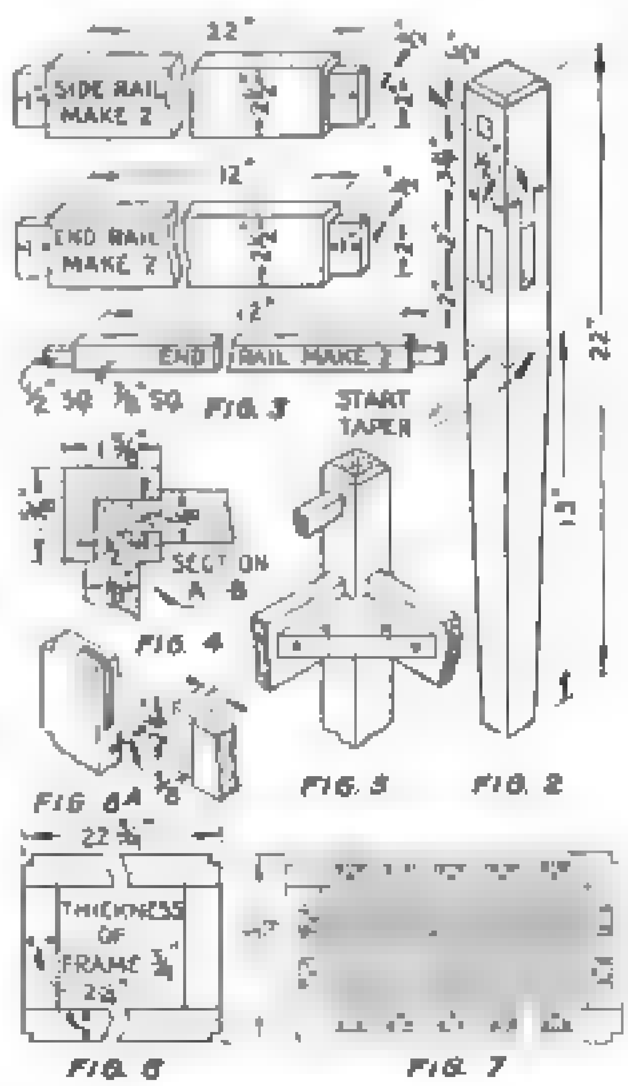
The method of fastening the corner blocks in place is clearly shown in Fig. 5. These blocks should be about ¾ in. thick and 3 or 3¼ in. on the sides. Drill four ³⁄₁₆-in. holes in each block as indicated.

In assembling, glue up the ends first. When these are thoroughly dry, glue up the side rails and then set the corner blocks in place. These are placed ½ in. below the top edge of the rails and are fastened first with glue and nails and later with screws.

The construction of the frame to which the upholstering is fastened is shown in Fig. 6. The length of the frame is the same as the distance between the end rails. The frame is held in place by screws which pass up through the corner blocks. Allow enough space between the frame and the rails for the upholstering cloth. Figure 6A shows the joint used in fastening the frame together, and Fig. 7 illustrates the method used in fastening the webbing to the frame. If webbing cannot be had, heavy canvas cut into strips and folded will serve.

After the webbing is in place, tack on a piece of burlap or other heavy cloth and then put on the padding material, making it slightly deeper through the center. Over this stretch a heavy cloth and then the upholstering goods. The final covering is tacked on the underside of the frame.

Make sure that all surplus glue is cleaned off the bench and then give it a coat of high-grade stain of the desired color. After allowing twenty-four hours for drying, apply one or two coats of white shellac, followed by one or two coats of varnish. Rub with No. 000 steel wool or with pumice stone and oil.

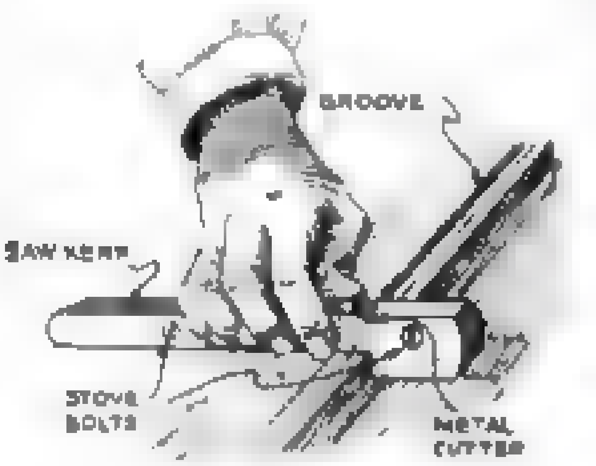


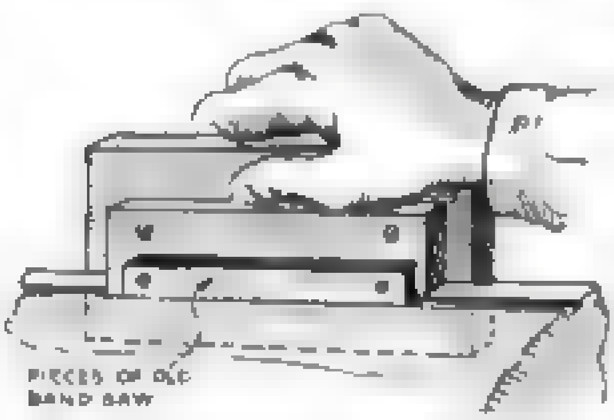
Details of the rails, leg, and corner joints for frame and top; how the webbing is applied.

TWO TOOLS THAT MAKE INLAYING EASIER

THE two homemade tools illustrated below are extremely useful for inlaying furniture and other woodwork.

In making the first tool shown, any hardwood such as walnut, oak, or maple will do. A piece 3/4 by 3/4 in. and 6 in. long is shaped as pictured, and a saw kerf is made to receive the cutter, which may be filed from a scrap of steel. A steel cut nail or a horseshoe nail will serve for making the cutter, and an occasional stroke with a file across the cutting end will keep it sharp. By shaping the cutter, the tool can be used equally well as a slitting gage or a fluting tool. The cutter is held in place with three or four stove bolts.





Since each tool has advantages for certain kinds of inlaying, it pays to make both

The second tool is made from two small blocks of wood and pieces of hack saw or band saw blades. The smaller block determines the distance the inlay will be from the edge of the piece being inlaid, so it is desirable to prepare a number of these blocks of varying thickness. Likewise, the width of the groove depends upon the thickness and number of the pieces of saw blades used, and therefore a supply of these should be kept on hand.

The groove in the work should be slightly less in depth than the thickness of the inlay. When the groove is ready, the inlay should be given a thin, even coat of glue and pressed into place. Cover it with strips of paper and clamp it with the aid of wood strips to insure an even pressure.

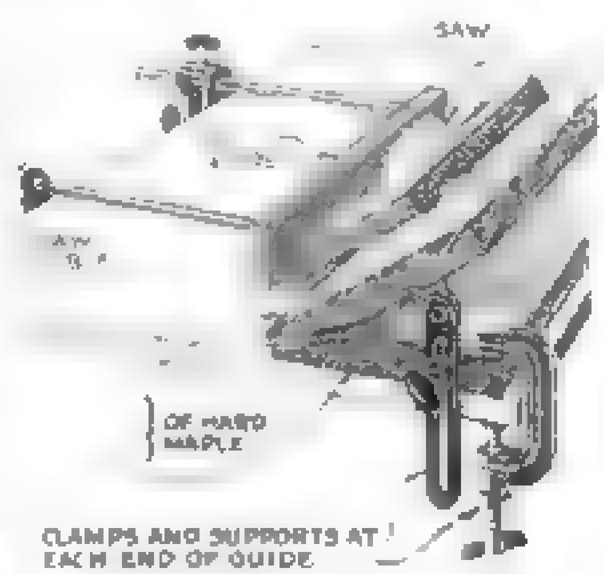
Where stain is to be used, the inlay should be shellacked with a small brush to make it impervious to the stain, as it is essential to preserve the natural colors of the inlay. If a band saw or a variety saw is available, very creditable inlays can be made by gluing together thin strips of different woods and after the glue hardens, again sawing the block at right angles to the glued faces. However, inlays cost so little that few craftsmen attempt to make their own.—A. E. Gray

BEVEL GUIDE FOR SMALL CIRCULAR SAW

SOME circular saw tables do not tilt and therefore cannot be used to cut bevels. To meet this contingency, the bevel guide illustrated was devised and found to work well.

If a guide of this type is to be used a great deal, it should be carefully constructed of hardwood. Suppose, for example, that the saw table is 27 in. long, cut two pieces from ¾-in. hard maple stock, one (marked A) 7 by 22 in. long and the other (marked B) 10 by 20 in. If the saw table is very small, these widths and lengths should be altered to suit.

Plane a bevel on one side of each of the pieces as shown in the drawing. This



Sketch showing the adjustable wooden bevel guide in place on a small rip-sawing saw table

bevel must be so wide that when finished it will allow the guide to be adjusted to run a bevel of less than 22½°. The average beveling work is between 22½° and 45°. Hinge the pieces together as indicated, the narrow piece at the top, using two small butt hinges. Mortise the hinges in the wood of each piece and fasten them securely with screws.

Place two small chest cover supports or stays as shown, one at either end of the guide, and provide a locking screw for each. Place the guide on the saw table and align it with the blade by measuring equal distances from the ends of the ripping guide. Hold it in place with two small C-clamps. Set the fence to the required angle with a T-bevel and bring up the rip guide of the saw to guide the outside edge of the work. (See illustration above.)—W. Clyde Lammey

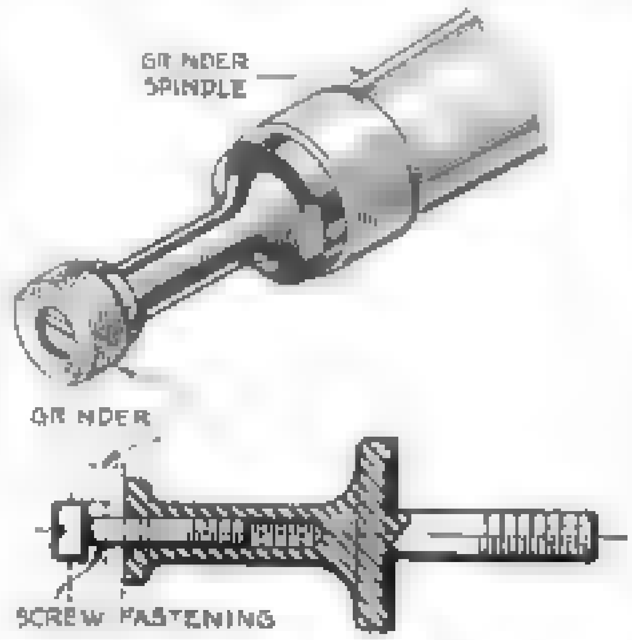
HOW TO GRIND HOLES OF SMALL DIAMETER

ANYONE who has had to grind an internal diameter and found that the spindle nose of the tool-post grinder would not go in, perhaps by 1/16 in., will appreciate the spindle extension illustrated on the following page. It costs very little to make, and for what it costs, it does a great deal.

With its aid, holes can be ground up to about 1½ in. long and less than half the diameter that can be handled with the regular spindle nose. A light cut and a slow feed must be used, and more time is

required than with a special high-speed attachment; but the work will be done and done right

For mounting the extension, it is necessary to have a screw hole exactly central in the end of the grinder spindle. The



Shopmade extension on the nose of an ordinary tool-post grinder for grinding very small holes.

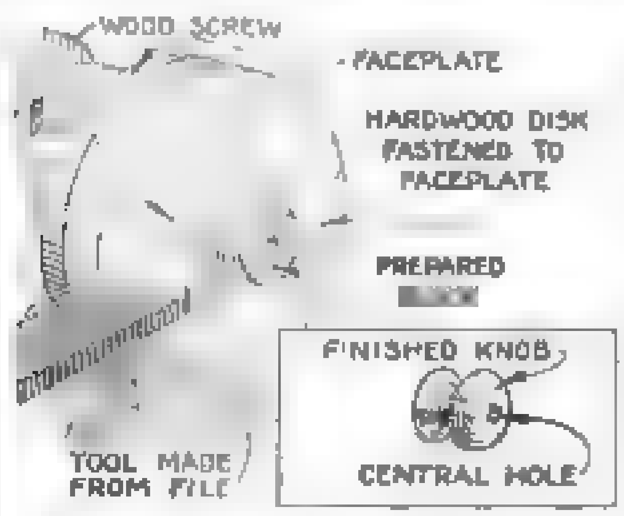
spindle and face should be trued up, if necessary. Both end faces of the extension should be relieved as shown, and the lands trued up on centers once more in the final operation

With an extension so made the wheel will run without any appreciable chatter. The grinding wheel screw, of course, should be made to fit the countersunk holes of standard small wheels.—H. S.

HOMEMADE TOOL TURNS KNOBS QUICKLY

SMALL wooden knobs can be quickly shaped in the lathe with a tool fashioned from an old file as shown below. In shaping the point of the file, be careful not to overheat the steel

Place a faceplate on the headstock of the lathe and fasten a piece of oak or maple to it. Turn the piece to the same



The wooden blank is first turned roughly to shape, then finished with the special turning tool.

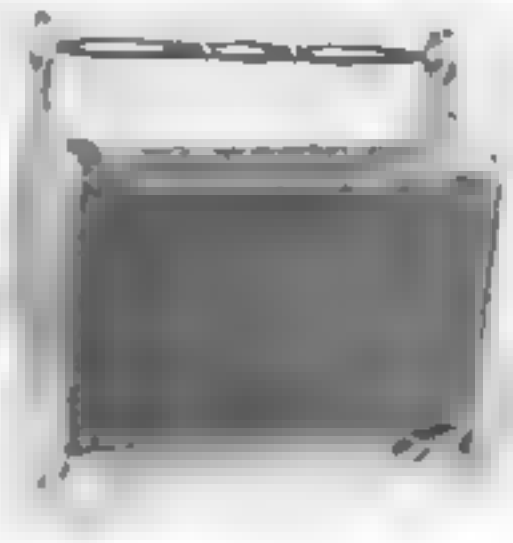
diameter as the plate, remove it, and bore a 3/16-in. hole exactly in its center. Place a screw in this hole and refasten the disk to the faceplate

Prepare the wooden knob blanks to the length desired, in the center of each bore a small hole; and fasten one on the screw Turn the blank down nearly to the diameter desired and then shape it with the special tool.—William Renfrow

Constructing a Magazine Holder

A new design that is generously proportioned and more graceful than most commercial models

By H. CALDWELL

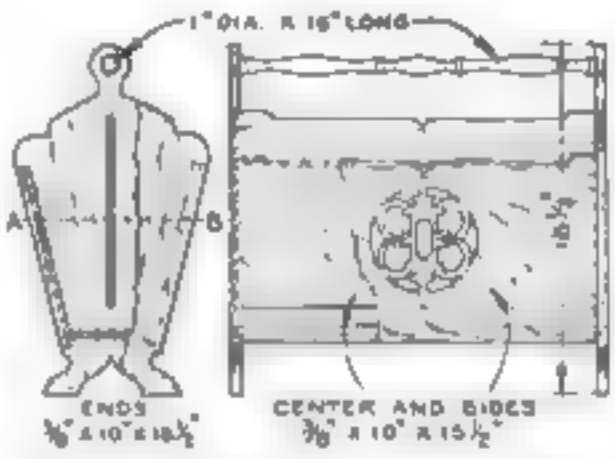


FOR the owner of a new motorized workshop who wishes to make something that will give the machines a good try-out, a simple and satisfactory project is the magazine holder illustrated. Unlike most commercial holders, which are too short, it is 15 in. long, inside measurement, and is designed with simple, well-balanced lines

The following units of the shop are used, combination, dado, and fret saws, lathe, and disk and drum sanders. The piece can be made, of course, without machinery, but the work will require a little more time

Plywood is the best material to use. Figured walnut, mahogany, or gum is excellent, or a commoner plywood may be used and stained to the finish desired. The plywood should have the same kind and grade of veneer on both sides. A standard ¾ by 20 by 60 in. panel will furnish sufficient material

The following stock is required, 2 ends 10 by 18½ in.; 2 sides and 1 center 10 by 15½ in. 1 bottom 6 by 15½ in., all ⅜ in. thick; 1 handle 1 in. square by 16 in. long, which may be turned to the design shown or merely rounded to a diameter of 1 in.



The finished magazine holder as made by Mr. Caldwell and the assembly drawings.

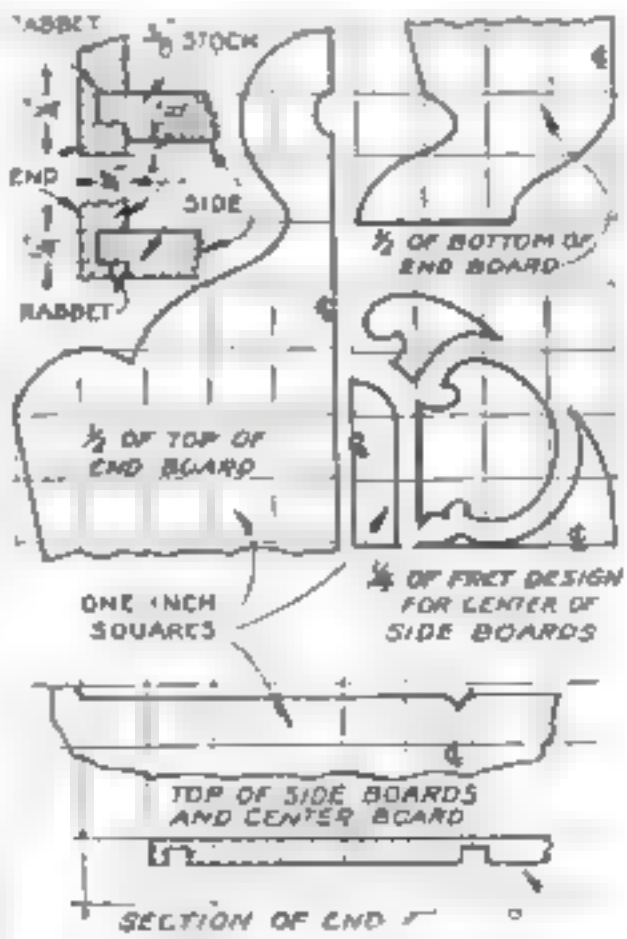
The sides, center, and ends are first cut to size The sides may have a fretwork design in the center, if so desired. After the sides are cut, a rabbet ¼ in. wide and ⅛ in. deep is machined on what are to be the front vertical edges. The tops of the sides and center are then fretted to shape. A groove ⅜ in. wide and ¼ in. deep is next dadoed in the center of the end pieces to receive the center partition. The ends are shaped with the fret saw, and a dado ¼ by ¼ in. made in both sides of the end pieces ⅜ in. from the edge to receive the sides, as shown in one of the joint details

This will bring the sides flush with the ends in the assembly. If a projection of ⅛ in. is wanted, the dado should be made ⅛ in. from the edges of the ends, as indicated in the other joint detail.

The bottom may be held with cleats or dadoed in the latter being the stronger and better way With the sides inserted in the ends, the position of the dado is marked on the ends ½ in. from the bottom of the sides. The handle is then turned, and rosettes are prepared to finish off the ends

Assemble the parts to see if everything fits. Then glue up the sides, center, and one end. When the glue is dry, fit the bottom, insert the handle, glue on the other end and apply the rosettes. Trim up with sanding disk or drum

Finish the wood, if walnut like the original holder, with a coat of raw oil and turpentine, half and half to bring out the color and grain. Apply paste filler, if desired, then spray or brush on three coats of clear lacquer. The edges of the plywood should be finished separately, since they must be stained to match the surface wood as accurately as possible



Details for laying out the curves and making two varieties of corner joints.

A definite program for getting ahead financially will be found on page four of this issue.

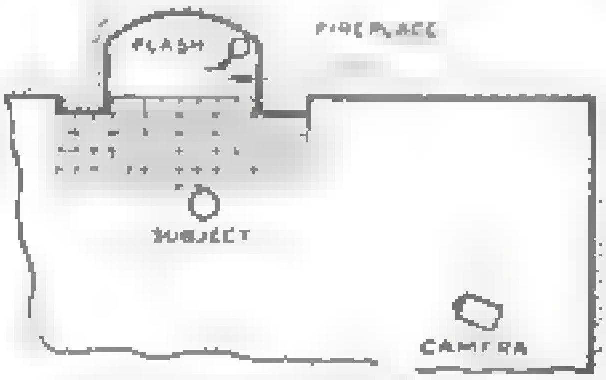
TAKING PHOTOS BEFORE AN OPEN FIREPLACE

Photograph taken by Mr. Pratt to illustrate his method of making realistic fireplace scenes.

ARTISTIC fireplace photographs can be taken easily at night so as to give an effect of illumination coming from an open fire.

Arrange camera and subject as suggested in the diagram below, the camera, of course, being on a tripod. The shutter should be set on "time," and the diaphragm at about stop F 16. The short focus lenses used in kodaks are especially suitable for these pictures.

Place a flash cartridge in the innermost corner of the fireplace toward the camera; this will prevent halation. Even if there is a log fire, it is well to set a crumpled newspaper ablaze before lighting the fuse of the flash cartridge. You will have ample time after lighting the fuse to get over to the camera to open the shutter.



After the flash, close the shutter, and the film is ready for development. Soft print paper should be used to tone down the high-lights.—J. G. PRATT

HOW TO USE SOAP FOR CLEANING FURNITURE

CASTILE soap is one of the safest and best cleansers for furniture and also for leather upholstery. Apply it with a cloth which has been dipped in water and then wrung out until it is only moderately moist. Remove the soap with a damp cloth and polish briskly with a clean dry cloth of soft and lintless texture. Better results are usually obtained in this way than by using prepared cleansers and polishes, many of which appear to give satisfactory results at first but ultimately injure the original finish. This is particularly true in the case of upholstery leathers, the finish of which is apt to become soft and gummy if cleansers are used which contain strong solvents.—L. D. T.

Cutting a Tricky Lock Joint

By E. C. WITTICK

RECENTLY I had occasion to make several small boxes of wood ½ in. thick. While planning the kind of joint to be used at the corners, I happened to recall seeing a neat and strong lock joint several years ago on an old oilstone box.

The lock joint is both simple and strong and it can be formed quickly on a small circular saw

The design of the joint was worked out from memory, and the result is shown in Fig. 1 on the following page.

This joint has many possible applications, and with a little ingenuity and experimentation it may be made in slightly varied forms and may even be combined with the miter joint as shown in Fig. 2.

In order to saw out the joints as quickly as possible, a system was devised for doing the work on any small, circular bench saw. Dimensions as given are for a saw ⅛ in. thick. If your saw is not ⅛ in. thick you can make the directions apply by substituting "one saw thickness" for each ⅛ in. given in the dimensions for saw setting.

To find the length of the boards for the sides of a box proceed as follows:

For side No. 1 (as shown in Fig. 1), make the boards 1 in. longer than the inside measurement of that side of the box. For side No. 2 make the boards ¾ in. longer than the inside measurement of that side of the box.

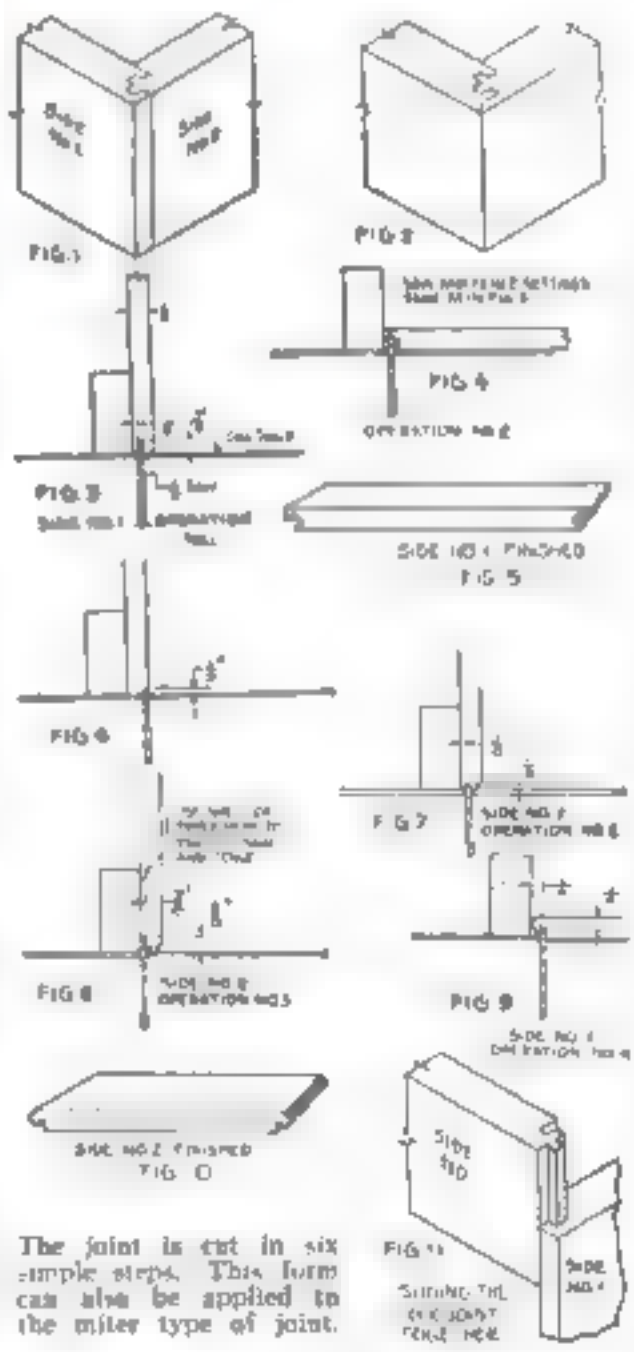
Extreme accuracy is required in all saw settings. Set the rip fence ⅛ in. from the saw, and adjust the saw to cut ⅜ in. deep. Make the edge cut and the flat cut shown in Figs. 3 and 4. Do this at each end of the board, making sure that the joint is on the same side in each case. The completely finished side No. 1 is illustrated in Fig. 5.

In cutting the joints on side No. 2 set the rip fence so that the saw will make a cut ⅛ in. in from the outer edge and ⅛ in. deep. Make the vertical cuts in each end, taking care that they are on the same side of the board. Move the rip fence to within ⅛ in. of the saw and make the second cut in each end as shown in Fig. 7. For the next cut stop the saw and carefully move the rip fence up so that it is almost flush with the saw, set the saw to cut ⅛ in. deep, ¼ in. deeper than the first two cuts and make the third cut in each end, as shown in Fig. 8. Set the rip fence ¼ in. from the saw, adjust the saw to cut within ⅛ in. of the top of the board, and holding the board in a flat position, make the fourth cut in each end as illustrated in Fig. 9. Side No. 2 should now appear as shown in Fig. 10.

For greater strength the joints may be coated with thin glue before being slid into position in the manner illustrated in Fig. 11.

The best appearance is obtained when the bottom of the box is set between the sides. If the box is to have a lid, this should be put on in such a way as to cover the joints.

When making a covered box, all parts should be first joined together in a solid unit, and the lid then sawed off. In this way a perfect fit between the lid and the sides of the box will be insured.



The joint is cut in six simple steps. This form can also be applied to the miter type of joint.

PAINTING always should be avoided while fresh mortar beds are in close proximity, on account of the tendency of the oil in the paint to absorb the moisture and fumes from the lime.

READERS SHOW INTEREST IN BOAT BUILDING

THAT boat building is a hobby with a surprising number of POPULAR SCIENCE MONTHLY readers, was indicated by the letters that came into the office for months after the publication of two articles on the construction of a family motor boat, the *Seascoot*, in the March and April, 1930, issues.

It was especially satisfactory to know that so many beginners had been encouraged to build their first boat. Indeed, the

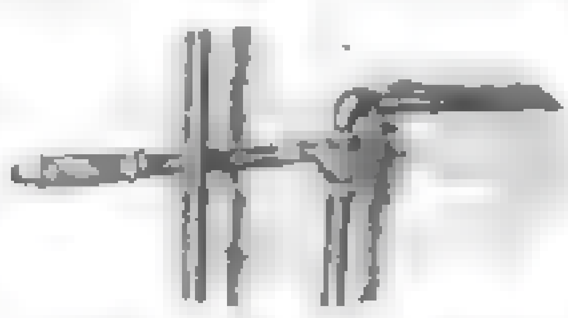
A boat built by Allen C. White, from plans in POPULAR SCIENCE MONTHLY

articles were written by W. F. Crosby, editor of *The Rudder*, with the express purpose of making the construction as simple as possible for those who were unfamiliar with boat building methods.

Among the readers who had never attempted such work before was Allen C. White, of Moberly, Mo., whose boat is illustrated and whose enthusiastic letter was published in one of "Our Readers Say" pages last month. Throughout the summer it has, to use his own words, given "wonderful service."

TURNING LEVER VALVES

LEVER handle stop valves, of the type ordinarily used where the water pipe enters the basement of a house and at the water meter, are almost invariably hard to turn. A wrench is often used to gain additional leverage, but sometimes the



How a pipe extension may be used to turn a stiff lever valve in an awkward place

valves are located in such awkward positions that a wrench is of little help. It is much better to use a short piece of pipe which can be slipped over the handle to act as an extension. Even so awkwardly placed a valve as that illustrated can be easily turned.—LAURENS E. LECHTEITNER

This Toy Airplane Does Everything Except Fly

By D. D. CALDWELL,
1st Lieut., 13th Field Artillery, U. S. A.

Driven by a gasoline engine, this little sport plane makes from two to nine miles an hour

TO BUILD an ideal present for my ten-year-old son and at the same time to design a practical ground training plane for boys from five to twelve years of age was the twofold purpose that led to the construction of the small airplane shown in the accompanying illustrations.

The controls are identical to those of a light plane, and all the parts are proportional, although the model was not, of course, made to fly. In general, the specifications are as follows:

Type: 2-place, open, land monoplane.

Dimensions: Length overall, 9 ft. 6 in.; height overall, 4 ft. 6 in.; wing span, 10 ft. 6 in.; wing chord, 23 in.

Power plant: 2½-H.P. air-cooled one-cylinder gasoline engine equipped with reduction gear and clutch.

Power is transmitted to a shaft underneath the engine through a sprocket and chain. On the left side the shaft extends out of the fuselage sufficiently to allow a sprocket to be mounted over the left landing wheel. From this sprocket another chain drives the plane by a sprocket attached to the left wheel. The plane has a maximum speed of nine miles an hour.

Since the model has the same controls as a real airplane, it provides a ground course in flying

Regular airplane controls are mounted

A rear view which shows the accuracy of detail in the fuselage, wings, struts and tail surfaces

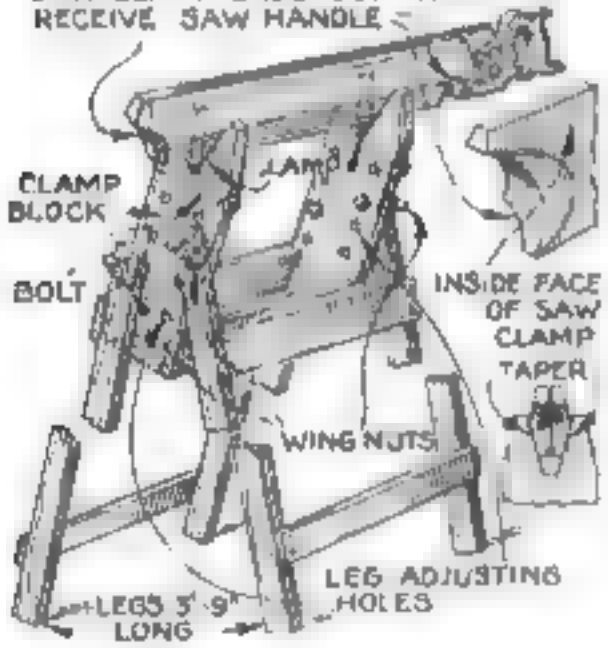
in the cockpit. The steering actually is done by the action of the small wheel under the lateral rudder

The propeller is driven at 75 R.P.M. by a leather belt which slips if the propeller hits anything. Every precaution was taken into consideration, for this plane is not only run by a boy but at times dozens of children are around it while it is in motion.

The clutch is operated by the left foot of the pilot. When the clutch control is pushed forward, it releases the engine, allowing the plane to come to a gradual stop while the engine runs freely. The propeller ceases turning when the plane stops. By letting the clutch control back and opening the throttle slightly, the "aviator" starts off

A SAW FILING CLAMP MADE OF WOOD

THE advantages of the homemade filing stand and clamp illustrated below are that it may be set up almost anywhere, that it is adjustable to height and angle to suit the direction of the light and the location where it is used, and, finally, that it allows the entire length of the saw to be filed on both sides without being removed from the clamp. It is also cheap



Sketch of the homemade saw filing stand and clamp, showing method of fitting the jaws

to construct, the cash outlay being limited to six bolts, preferably of ¼-in diameter

In designing and making the stand for my own use, I constructed it from fairly heavy stock. The legs are 1 by 1½ in. by 3 ft 9 in; the notched clamp blocks for holding the jaws, 1½ by 5 by 20 in.; the crosspieces at the bottom of the clamp blocks, ½ by 3 by 20 in.; two pieces at the top, not shown in the drawing, ½ by 2 by 20 in.; the crosspieces near the bottom of the legs, ½ by 3 by 22 in.; and the upper crosspieces, ½ by 4 by 22 in., these being about 1 ft. from the top of the legs. The jaws are made from pieces 1 by 4 in. by 2 ft. 4 in. tapered and shaped as shown in the detail sketches.

About the only improvement I might suggest is to make the stand less bulky and to provide an adjustable seat that also will hold it down.—E. E. WOLTER

FLYING WITH A TEST PILOT

(Continued from page 24)

was due to the fact that the air was getting thinner, making the readings of the instrument inaccurate, less than the actual velocity of the ship

In the course of our long climb we had swung out over Oyster Bay and Long Island Sound. Fleets of moored yachts, like tiny bits of floating driftwood, lay clustered in the harbors. The green patchwork of Long Island spread out below, a score of tiny yellow planes the size of flies marking Mitchel Field. We could see the glittering spire of the Chrysler Building and make out the toy skyscrapers of Manhattan, thirty miles to the west. We could follow the thin white line of the Hudson as far as Bear Mountain, see a faint yellow streak in the Atlantic, Sandy Hook, make out the dim curve of Montauk Point, the far end of Long Island, nearly 100 miles away

LAST March, Crosswell took a Curtiss "hangbird," with two 300-horsepower Wright engines, up to 26,500 feet over Mitchel Field. It was fifty degrees below zero at the peak of the climb and he had to breathe oxygen continually. Another test pilot at Wright Field, Dayton, Ohio, some time ago, had a thrilling adventure while "at the top of the sky" on an altitude climb. Above the "deadline" of 30,000 feet, the tube of his oxygen tank accidentally slipped from his mouth. Before he could bend over and pick it up, everything turned black. He had "passed out" in the thin air. When he regained consciousness, the ship was plunging toward the earth, the altimeter hand pointing to 8,000. The plane with its unconscious pilot had fallen four miles through space.

During our descent, Crosswell showed me how the stability tests are conducted. After adjusting the stabilizer to hold the plane in level flight, he pointed to the nose of the Falcon. It began to drop. We were diving. The hand of the air speed indicator crept ahead to 110. The green patchwork of the fields rushed up toward us. Then Crosswell calmly removed his hand from the stick and placed it on the side of the cockpit. I clung to the longerons beside my seat. After a few seconds of diving, the nose began to rise. It swung slowly above the horizon, then seesawed deliberately up and down, settled even with the line where the sky and the Atlantic met, and we were flying level again. A properly designed ship is required to retain normal flying position when the controls are released under such conditions.

NEXT, the nose was pulled up into a climb. Again, Crosswell's hand appeared on the end of the cockpit. The ship was flying itself. Again the ocean seesawed before the blunt nose of the Falcon and again the machine ended in level flight. Next Crosswell swung the stick to one side. A wing dipped low. With the stick released the drooping wing slowly rose as if by magic and the plane sailed along once more in normal position. The other wing was similarly dipped and rose of its own accord. Crosswell grinned back. Then he kicked the ship into a turn and took his feet from the rudder pedals. Gradually the nose crept back until we were flying straight again. Then he put the Falcon into a spin, released controls and let her straighten out.

On practically all tests, when an observer is not carried, the maximum load is taken in the form of lead shot. This ballast is done up in canvas strips sewed together. They suggest huge waffles. Each "waffle" weighs five

(Continued on page 136)

FLYING WITH A TEST PILOT

(Continued from page 136)

ten, or twenty pounds. They are strapped or wired in place securely so they cannot break loose. When Crosswell tested the huge "Condor," he carried 3,000 pounds of birdshot as ballast.

Sand was used in place of birdshot a few years ago when Thomas Carroll, famous test pilot of Langley Field, Virginia, was carrying on experiments with ailerons. He attached two sand boxes to the wing tips of his machine so arranged that he could release their contents at will. In the air he could let the sand run out of one box and then measure the pressure on the stick required to hold up the weighted wing with the ailerons.

ONCE, he took off in a midwinter test and at 5,000 feet let out the sand in one box. When he finished his tests, he jerked the trip to let out the sand that was pulling down the other wing. The trip worked but the sand stayed in the box. It had been slightly damp and had frozen solid. Carroll couldn't land with the weight on the wing because as soon as the speed dropped off in coming to earth the ailerons would no longer be able to keep the dragging wing up. For five minutes he dove, waggled the stick, and rocked the wings, trying to shake the frozen chunks loose before he succeeded.

Another unusual experiment with ballast was carried on by Lieut. Harry Sutton, a young Army flyer at Wright Field, Dayton, Ohio. Sutton made more than 3,000 tail spins seeking to learn their secrets and rob them of their menace. He placed a cylindrical can of BB shot at the rear of his plane arranged so its contents could be released through a trapdoor in the fuselage if necessary. Day after day more shot was added while Sutton went up and spun the plane with its increasing load.

Each time, as the center of gravity moved more and more to the rear, the ship proved harder to bring out of the spin. Finally Sutton reached a point where it kept spinning until he dumped the load—when only 1,000 feet from the ground. Such tests are far from dare-devil stunts. They are cold-blooded investigations that teach the engineers how to make the air lanes safer for everyone.

IN SPIN tests, ballast takes the place of an observer, always. One life is enough to endanger in these gyrating plunges in a ship out of control. The Department of Commerce requires that every plane it licenses shall demonstrate that after a spin of six complete turns, it will come out in one and a half turns after the controls have been neutralized. If the plane won't do that, it is reengineered until it will. With the ground blurring past the nose of the machine at dizzying speed, it is difficult for the pilot to keep track of the turns in a spin. Usually he picks out some prominent landmark, easily seen from the cockpit, counting the number of times it goes by. In one test, a few months ago, Crosswell purposely spun down for 5,000 feet, making twenty-three complete turns before coming out. The average plane spins about five turns in a thousand-foot drop.

When giving a new ship a spin test, the pilot notes particularly any unusual pressures on the control stick, any bobbing of the nose, or any tendency of the nose to rise into the dreaded flat spin, the type most difficult to recover from.

Because a trained engineer can tell most from such first-hand observation, the majority of test pilots have engineering background. More technical knowledge is required for such work than for other types of flying, for the test pilot is often relied upon to aid the designer in "ironing out the engineering bugs" that sometimes appear in a new plane. His work supplements the wind tunnel tests which are the basis of modern aircraft construction. Because of the small scale wind tunnel models, errors may creep in. At Langley Field, the huge tunnel is equipped to use air compressed to twenty times that of the ordinary atmosphere. The effect is the same as increasing the size of the models tested.

While we had been making the stability tests, the Falcon had descended to 3,000 feet. As we came in for a landing, a red sport plane from Roosevelt Field crossed our path a thousand feet below, trailing its shadow on the ground. In the hangar, after the flight, Crosswell explained some of the other rigid tests that a new type of ship must undergo. His voice, and all ordinary sounds, seemed faint and far-away to my ears, deafened by the roar of the big Conqueror.

BESIDES the tests which we had made, the pilot must find out the stalling speed of his plane with the motor off and also with the engine on full and the ship pointed up until it is "hanging by its prop" in the sky. He must discover the lowest possible landing and take-off speed, the shortest run required for landing and taking off, and the performance of the plane with different loads. When he finishes, he writes a letter to the chief engineer of the company making the plane, giving all the data he has collected during the tests. One pilot carries out the tests from beginning to end.

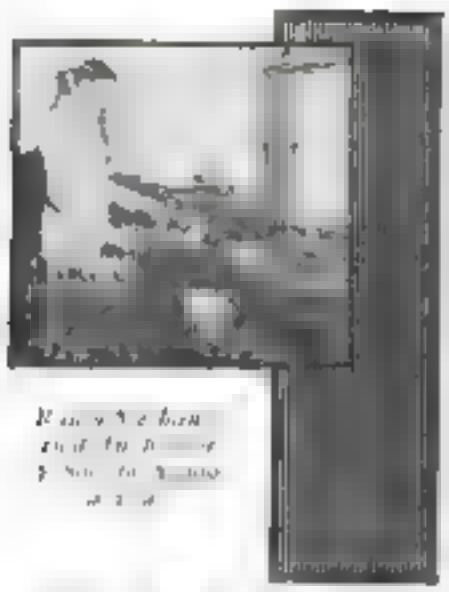
Sometimes there are special requirements that have to be met before a plane is accepted by a customer. Last spring, a high-speed, two-place observation ship, the "Hell Diver," was built for the U. S. Navy by the Curtiss company. The contract stipulated that it must be capable of making a vertical dive of 10,000 feet. Some people thought that such a dive would wash off the wings. It was up to Crosswell to prove that it wouldn't.

He climbed to 17,000 feet above Anacostia Field, near Washington, D. C. Then he hurled the bullet-nosed "Hell Diver," with engine roaring, into a perpendicular plunge aimed directly at the tiny air field straight below.

"ANACOSTIA field wasn't any larger than a postage stamp when I started," he told me. "But it spread all over the map as I dove."

At the end of 1,500 feet, the ship was traveling between 200 and 300 miles an hour. It was moving faster than the propeller could pull it and he had to shut off the racing engine. In less than thirty seconds, he had rocketed down through 10,000 feet of space. When he began to level off, terrific centrifugal force jammed him down in his seat as though he tipped the scales at six times his actual weight. A too sudden halting of the plunge would have driven the blood down from the pilot's head, "knocking him out."

The work of a test pilot is packed with swift-moving adventures. But they are the kind of adventures that have practical value, that teach aeronautical engineers to make better planes, that contribute largely to increasing the safety of those who travel by air.



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ODD RULES HAMPER OUR CARS ABROAD

Continued from page 41

piled up against the upstream side of the body and poured over into the driver's compartment, drenching him to the waist. Finally, he hit upon the plan of tying both front doors open. After that, the current roared through his compartment and only his feet and ankles got wet.

After a car is sold, delivering it frequently presents additional problems. A few years ago, a buyer asked to have a machine delivered to him on a high plateau of the Andes Mountains in Peru. There was a good road on the plateau although nothing but llama trails led up the steep sides of the mountains. The only way the automobile could be transported to the plateau was by taking it to pieces and packing it up the winding trails on the backs of the llamas.

Deliveries in certain sections of India cannot be made on Tuesdays or Saturdays. According to the Hindu Calendar, these are inauspicious days for business deals and customers refuse to accept cars then. The time of day at which a new automobile is accepted is also given careful consideration. A certain hour is referred to in the Calendar as The Poisonous Hour when no buying, selling or bargaining is to take place.

ONE Hindu custom has given the auto salesmen a talking point which they have not been slow in using. This is the common practice of marrying in a neighboring village. This results in a great deal of inter-family travel and much of it is now done by automobile.

Religious pilgrimages also help the sale of moderate-priced cars in India. Nearly a million worshipers each year go to Benares, the sacred city of the Hindus, many of them going by motor car.

Will the adding of an accessory, popular in America, help the sale of a car in a foreign land? That is a question the manufacturer must ask himself. He is never quite sure. For instance, a year or two ago a shipment of American cars reached Russia in South America, each of which had been equipped with a china new electric cigarette lighter. The maker expected them to attract favorable comment. They attracted comment but not the kind desired.

The purchasers found they could not run their automobiles without paying a special tax on cigarette lighters. The Bolivian government operates a monopoly upon matches and has passed a law making it illegal to use a cigarette lighter without paying a tax.

When American manufacturers began invading foreign markets with their motor trucks, they ran into several unexpected objections to their use.

In Spain, when the drivers of horse-drawn trays had to begin operating motor trucks they protested violently. It seems that they had been in the habit of climbing to the tops of their loads, on night hauls, and taking cat naps. The horses knew the road and needed no guidance. But gasoline trucks wouldn't steer themselves, and the drivers had to stay awake.

WHEN the trucks were sent to Calcutta, India, they had to compete with "human dray horses," husky native porters who carried immense loads on their backs and worked for ten cents a day. With such competition, the dealers had a hard time introducing their large machines.

In many countries drivers must keep to the left-hand side of the road instead of the right. Consequently, the machines are required to have the steering wheel on the right side and American cars sold in these countries are so equipped.

Other traffic rules sometimes affect the sale of motor cars abroad. In Copenhagen, Denmark, and in Amsterdam, Holland, workmen almost universally ride bicycles to work. This bicycle traffic is so heavy that certain streets are closed to auto travel during the morning, noon, and evening rush hours to give the two-wheeled vehicles complete right of way.

One of the strangest traffic regulations is in effect at Dirkvaley, near Stavanger, Norway. A single narrow road winds up the mountainside. All morning, the one-way traffic is up and all afternoon it is down.

THE superstitions of the people have much to do with regulating traffic in India. For instance, it is considered unlucky to travel west on Friday or Saturday, east on Monday or Saturday, north on Tuesday or Wednesday, and south on Thursday. It is held that a traveler who sets out on a journey on Tuesday will have his house burn down or will be robbed by thieves while he is away. If he leaves on Saturday, the same misfortunes are likely to befall him. If he begins his trip on Sunday, he is sure to fall sick on the way. Only Wednesday and Friday are considered propitious days for starting a journey. Consequently, most of the traveling is done then.

In South Africa, many highways are toll roads with gates at such frequent intervals that it is customary to carry a servant to open them. Hence, it is frequently necessary to provide some sort of separate compartment for this servant in order to sell American made cars in this part of the world.

In other countries, where women are required by custom to be screened from sight when they travel abroad, special curtains must be installed as part of the regular equipment of motor cars.

Improvements in automobiles accepted in America are not always appreciated in foreign lands. Several years ago, when headlights which diffuse the illumination were introduced in place of the glaring lamps that had been used heretofore, the salesmen in foreign countries found there was no demand for them. The car with the brightest headlights sold the best. No matter how carefully the factory engineers focus the lights down to the road and devise ingenious arrangements of bulbs, reflectors, and lenses, owners in some countries will turn these lamps upward until they glare directly into the eyes of other drivers. The theory is that the man with the brightest lights will see best and salesmen for American-made cars have been unable to convince these foreign buyers that the rule does not hold good.

NOT long ago, a globe-trotter who has traveled more than a million miles over the surface of the earth returned from a trip around the world with this comment:

"Travel in far-off countries is just one automobile after another. Gone are the stately, stiff-legged camels, the ponderous elephants, the lonely caravans. There's a filling station at every oasis in the Sahara and from Rangoon to Mandalay the road is lined with signs reading 'We Fix Flats.'"

In bringing about this dramatic change in world travel conditions, American manufacturers have played a leading part. And in introducing their machines into the far corners of the globe they have met and untangled a host of unusual and unexpected problems.

RADIO NOW WALKS, RIDES, AND FLIES

to the man carrying it on his chest. The microphone is a close-talking one padded in back and mounted in a small leather case. Fastened to this is a leather strap with buckle, enabling the wandering or flying broadcaster to strap the device around his head.

Columbia's thirty-five-pounder is designed mainly along the same lines. It is a five-watt transmitter used at half power. Ted Husing uses a [illegible] mike of his own design which may be carried in the hand or fastened to [illegible] holders when the announcer needs his hands to hold notes or field glasses. Both the N. B. C. and Columbia pygmy transmitters are used with wire antennas.

THE reason for the difference in weight and power between the two is that the N. B. C. outfit, lighter by eleven pounds, was designed originally to broadcast the sensations of a parachute jumper while descending, while the Columbia unit was made especially to broadcast sports reports. N. B. C. has used its tiny transmitter for a year, and Columbia's has been in service seven months.

The various types of short wave transmitters are operated on wave lengths ranging from 125 to 200 meters which, of course, is just below the regular broadcast band.

If the short wave program is broadcast from a remote place, no matter by what variety of portable transmitter, temporary short-wave receivers and [illegible] amplifiers are set up at points easily connected with telephone wires. These receivers function just as your receiving set at home does, except that the sound impulses are fed into a wire line instead of into a loudspeaker.

Converted from radio into audio frequency, they are carried by wire to the nearest network control point, say New York City. There the sound again is amplified and sent by wire to the power transmitters at the regular broadcasting stations, which put it on the air on the longer broadcast wave.

For the reception of short wave programs broadcast in or near New York City, N. B. C. recently established a special short wave receiving station at Woodridge, N. J. The principal reason for this was that N. B. C., taking another leaf from the news movie companies, now has a broadcast truck, the latest development in short wave transmission. This is a broadcasting station on wheels that can be rushed at a moment's notice to the scene of an important news event.

THE obvious advantage of the permanent short wave receiving station is that it eliminates the delay of setting up temporary receivers and wire lines. It was established outside of New York City because the steel buildings, elevated railroads, elevators, and other machinery there were found to interfere greatly with short wave reception.

N. B. C.'s roving station is set up on a one-ton truck equipped with unusually heavy tires and special shock absorbers to minimize vibrations, as well as with shielded spark plugs to prevent interference from that quarter. It is provided with a one-half-inch copper pipe antenna mounted permanently on the roof. This antenna is so constructed and insulated as to give the maximum radiation efficiency with the truck in motion.

An opening in the roof is large enough to admit the head and shoulders of the announcer, who thus can see in any direction and hear without leaving the vehicle. The microphones are portable, and the leads range from fifty to 1,000 feet in length, so that the announcers (Continued on page 14[illegible])

A definite program for getting ahead financially will be found on page four of this issue

RADIO NOW WALKS, RIDES, AND FLIES

(Continued from page 141)

may carry the mikes as near the scene to be described as necessary. The truck is manned by two announcers, two engineers, and a driver.

The first, and thus far the only time, the mobile station was used was in Admiral Byrd's parade of welcome in New York City in June. It still is in the early experimental stage. Its fifty-watt short-wave transmitter weighs more than 1,000 pounds, including batteries and amplifiers. N. B. C. engineers are trying to reduce this weight to a point where the transmitter may be lifted quickly and easily from the truck and loaded onto a boat, train, or airplane.

To enable studio officials to keep in constant touch with the announcers aboard, a short-wave receiver, tuned to a transmitter at the Woodridge, N. J., station, was also installed. Thus the truck is a combination broadcasting station, studio, and receiving station on wheels.

Broadcasting programs by short-wave transmission is comparatively new. The first time N. B. C.'s 300-pound portable was brought into play—which, incidentally, also was the first time a radio program was broadcast from a plane—was on Washington's Birthday, 1929. Burke Miller, N. B. C.'s director of special events, had conceived a stunt known as "Over and under New York in One Hour."

LESLIE JOY, announcer, was to fly in circles over the city for twenty minutes, describing its appearance from a height of 1,500 feet. He then was to land at Newark, N. J., airport, rush in an automobile under police escort to an excavation at Canal street and the Hudson River, New York, where construction of a tunnel under the river was in progress, descend sixty-six feet and walk out into the tunnel for a distance of forty feet and again describe what he saw. The idea was to give a bird's-eye and groundhog's view of the city within one hour.

On this occasion of short-wave broadcasting's debut, trouble, its almost inseparable companion, was in top form. Here is how Miller, who accompanied Joy, told me what happened:

"We had guaranteed that, if the studio would give a 'fill-in' musical program while we were speeding from airport to tunnel, we would make it in twenty-two minutes. We had been promised police escorts from Hudson and Essex counties, N. J., and New York City. The Jersey police met us on time, but they couldn't help that the drawbridge over the Hackensack River was opened, which delayed us three minutes.

"ON THE New York side, the police missed us, so we didn't arrive at the top of the excavation until twenty-seven minutes after landing in Newark. When we didn't appear on the dot, our relief announcer at the tunnel stepped into the equalization chamber maintained at such jobs to provide a transition between normal air pressure and the high pressure below. Just as we drove up, the door of the chamber clanged shut, not to be reopened for twenty minutes. The portable in the plane worked like a charm, but the radio audience got the ground-hog's view through another voice."

Short-wave next played a spectacular part at President Hoover's inauguration. A short-wave transmitter, tuned to a receiver at WRC, National Broadcasting Company's regular station in Washington and a short-wave receiver tuned to a transmitter at WRC, were placed aboard an Army plane flying over the capital.

In addition, *(Continued on page 143)*

A definite program for getting ahead financially will be found on page four of this issue.

RADIO NOW WALKS, RIDES, AND FLIES

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five announcers were stationed at as many points on the ground, each of them linked by wire line to WRC. When the ground announcers spoke, their voices were heard, via WRC by the radio audience and by the announcer in his plane. When the latter spoke, his voice was broadcast by WRC to the radio listeners, the five ground announcers, and back to himself. This was the first time a man in the air carried on a conversation with his associates on the ground, hearing himself talk by radio in the bargain!

Even more remarkable, from a radio engineering standpoint, was the broadcast of the recent Presidential review of the Atlantic Fleet off Hampton Roads, Va. In this broadcast listeners heard announcers speak from the top of a hotel at Virginia Beach, from the Navy dirigible *Los Angeles*, and from the cruiser *Salt Lake City*.

THE dirigible carried a short-wave receiver, a long-wave receiver, and a seven and one half watt short-wave transmitter. On the *Salt Lake City* was a fifty-watt short-wave transmitter and a long-wave and a short-wave receiver. On top of the hotel at Virginia Beach, the control point for the broadcast, were two short-wave receivers and a short-wave transmitter. From a mixing panel at the control point a wire line took the program to National Broadcasting Company headquarters in New York and thence to transmitters of WJZ, WEAF and the network.

Here is what actually happened. Miller, who was in charge, was at a microphone on top of the hotel. He called George Hicks, announcer aboard the *Los Angeles*, and James Wallington, announcer aboard the *Salt Lake City*. Listeners heard him call and heard Hicks and Wallington answer. But in order to speak to the announcers fifty miles away, Miller's voice traveled to New York and then came back by radio from WJZ and WEAF to be picked up by the announcers afloat and in the air.

When Hicks spoke his voice went by short waves to the receiver at Virginia Beach and then on to New York. Wallington's voice traveled the same route, but when Hicks heard Wallington, or vice versa, their voices went first by short-wave to shore, then by wire to New York and to the WJZ and WEAF transmitters and then back by radio.

Difficulties were many in connection with the broadcast of the Byrd reception. Not until two days before did anyone know whether the parade would end at the New York City Hall or proceed further uptown. For two months previously, National Broadcasting engineers had been making tests to find in what zone between Battery Park and Fifth Avenue at Sixty-sixth street, where the reviewing stand usually is set up, they could best depend on the new mobile transmitter.

THEY found, for example, that the canyon of lower Broadway was poorest because of its towering steel structures. On the other hand, upper Fifth Avenue, which is much wider and has lower buildings, proved to possess acceptable quality. Because of interference, the receivers had to be set up directly on the line of march. Seven of them were established along the entire route. But the engineers saw that, at all of these points, ordinary antennas for reception would not do. They decided that, to "get" the truck, antennas had to be strung across the street. Permission to do this was asked and obtained from the police and the owners and tenants.

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RADIO NOW WALKS, RIDES, AND FLIES

(Continued from page 143)

Then what happened? Just two days ahead of the show, it was decided the parade was to march only as far as City Hall. This knocked out five of the seven receivers. And the truck was used for a distance of only four blocks!

ADMIRAL BYRD and his men arrived at noon on a Thursday. A few days before the National Broadcasting Company engaged the *Relief*, largest tug in New York Harbor, and on Tuesday evening Miller accompanied by Wallington, the announcer, and three engineers, set out to sea to find Byrd. This is how Miller told me the story.

"At 4:20 o'clock on Wednesday morning, in the semidark, we sighted the *City of New York* in tow of the *Eleanor Bolling*. F. V. Becker, one of our laboratory engineers, was so excited he couldn't wait to set up his short-wave transmitter. He ran up to the bridge of the *Relief* and, with an ordinary hand flashlight, began to talk to the *City of New York* in flash code. Immediately, a blinker light at her topmast answered, inquiring who we were. Becker wore out two flashlights explaining what it was all about.

'Then we were asked to come alongside and the conversation was continued through megaphones. From our side, it was conducted by Wallington. Before he had had time to identify himself, the explorers recognized his voice, shouting, 'Hello, is that you, Jim Wallington?' Jim's was one of two voices from home the men had heard regularly during their two long years in Little America.' As announcer for station WGY, of the General Electric Co., Schenectady, N. Y., which every other Saturday night sent messages to the expedition, Jim had been a link between the explorers and their families and friends.

"IT was now almost six and beginning to get light. Admiral Byrd, through a megaphone, asked us to stand clear until full daylight, promising to talk to us by radio at eleven. He then invited us aboard. Wallington and I set out in a small launch in a rough sea. Neither of us felt so good. When we finally saw the Admiral, he told us he had a certain radio contract of which he feared our stunt might be a violation.'

But the radio men are used to disappointments. N. B. C.'s twenty-four pound transmitter was designed especially for use by the late Henry J. ("Buddy") Bushmeyer, the parachute jumper and instructor (P. S. M., July '30, p. 23; Aug. '30, p. 66), who was to describe his sensations while jumping from a plane. In seven tests, everything went fine, but in the broadcast, poor "Buddy" became "mike-shy" and forgot to talk.

However, a few weeks previously, the pigmy transmitter had been given a successful trial in Floyd Gibbons' walking broadcast at Lakehurst. Miller and another N. B. C. official, carrying ten-foot bamboo poles between which the antenna was strung, followed Gibbons wherever he went, like fan bearers behind a sultan.

Endless tests and untold trouble are the price paid by radio engineers for the entertainment and information of the listeners. When, beginning September 13, the yacht races for the America's Cup are run off at Newport, R. I., the radio audience, it is planned, will hear Samuel Whetherill, experienced yachtsman and writer on the sport, give a description of the event from the crow's nest of a Navy cruiser.

As I write this—weeks ahead of the race—engineers are making elaborate tests to determine the best pick-up point for the broadcast.]

American Unknown to Fame First Man to Leave Earth on Wings

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location was a hillock about three and a half miles from home, south of the valley of the Otay.

We arrived before dawn. Everything was in readiness for the trial flight as soon as the sun rose. However, the first glide was not made until a gentle breeze sprang up from the west. My brother placed himself in the glider. There was a rope attached to the forward part which I was directed to pull. Upon receiving the signal, I ran with the rope. The glider rose beautifully in the air. It passed over me and traveled something like 600 feet."

SEVERAL other shorter flights were made the same morning. They ended when James accidentally held the rope too long and the glider crashed on one wing and was damaged. Later, accompanied by Charles Burroughs, Montgomery made a number of 200- and 300-foot glides the same year. In his famous book, "Progress of Flying Machines," published in 1894, Octave Chanute reports Montgomery's success, as does Victor Lougheed, former Secretary of the National Aeronautic Association, in his "Vehicles of the Air." Singular enough, many later histories of aviation give Montgomery scant space and some omit his name altogether.

The weight of this first glider was only thirty pounds and that of its rider 130. About this time Montgomery tried to build an engine, but his homemade castings were unsatisfactory. Once he tried to rig up a propeller he could turn by hand but he found that maintaining balance required all his attention in the air.

Seeking a better method of keeping the machine flying level, he designed his second glider, a larger machine equipped with hinged ailerons at the rear of the main wing. This was in 1885, a quarter of a century before aileron balanced planes became common. Wind tests showed it was more stable but it refused to fly. Montgomery had made the mistake of constructing the wings flat instead of curved.

In 1893 he visited the Chicago World's Fair to attend the Aeronautical Congress. Here he met Octave Chanute. This famous aerial pioneer at one time proposed that they experiment jointly at the Otay farm. His trip showed Montgomery how little the great scientists of the world really knew about the laws which govern human flight. He decided to begin at the beginning and for the next ten years experimented with models instead of large machines.

IN 1903, he stretched a cable 150 feet above a valley at Santa Clara, where he had assumed the position of professor of physics at Santa Clara College. From the cable, he dropped models, some weighted with several pounds of rock, upside down and in all positions until he was sure he had perfected a design that was stable.

The following year, he completed a full-size tandem monoplane. In the steep San Juan Mountains, a hundred miles from Santa Clara, he tested it with the help of three cowboy friends. The craft revealed remarkable powers of flight, but the tests came to an end when Montgomery put his foot in a squirrel hole in landing and sprained his ankle.

Few of his associates at the time took his experiments seriously. They frequently spoke of him as "a man who has turned great talents to little use because of an airship mania." Only *(Continued on page 146)*

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a handful of people then believed in the practicability of aerial travel. Montgomery resolved to silence his critics by a dramatic demonstration. He hired Daniel Maloney, a professional parachute jumper, to ride his craft several thousand feet into the air attached to a hot-air balloon and then cut loose.

On April 29, 1905, fifteen thousand people gathered at the little mission town of Santa Clara to witness the spectacular exhibition. The white-winged glider with red tips was christened the "*Santa Clara*" and was attached to the swaying, bulging, hot-air balloon. Maloney, "known to fame as Professor Lascelles," appeared wearing brilliant silk tights familiar to parachute jumpers at country fairs.

"AT ELEVEN A.M.," says a contemporary account, "the big balloon began to writhe and shift from side to side in an effort to leap into the air; it seemed anxious for the ascent. The aeronaut was in reality anxious as he took his place on the saddle of the aeroplane and waited. Photographers were busy at work, reporters were plying their questions; the neighboring housetops were filled with onlookers and those who had been admitted to the vineyard moved to and fro and made their comments in a fever of excitement.

"'Goodbye, everybody!'

"This farewell was shouted in a clear resonant voice by the aeronaut. For an instant he was seen darting glances about to see that the ropes were free and then, like a rocket, he left the ground.

"'Goodbye!' sounded from many throats.

"Up, up went the balloon until it became a speck in the azure depths. When, at a height of some 4,000 feet, the balloon and the aeroplane separated, the hearts of the spectators throbbed anxiously; but as the balloon heeled over and dropped earthward leaving the aeroplane on high, the shouts and cheers became deafening."

For more than twenty minutes, Maloney dipped and spiraled, sometimes diving at a speed estimated at sixty-eight miles an hour. He had been directed to return to his starting point. But, as he cut free from the balloon, he lost his direction and started to fly toward a distant city. In five or six minutes he detected his mistake and turned about. In coming down he passed through two clouds. Because he had lost much altitude on his flight and there was a forest of tall trees he did not want to cross, he decided to land at a point three-fourths of a mile from the place where the balloon ascended. He made a half-circle and came to earth so gently that, although he landed on his feet and had to support the forty-eight pound glider with his hands, he was not even jarred. This light machine had carried its 150-pound rider on a flight of eight miles.

THE next day, the newspapers of the country were filled with the exploit. Over the San Francisco *Bulletin's* full page story, was the headline:

"WINGED MAN RIVALS BIRDS ON HIGH AND SWEEPS SKYWARD RISING IN MARVELOUS AEROPLANE."

Another heading declared:

"PAINTED BUTTERFLY SOARS, SOLVING PROBLEM OF SAILING HIGH IN THE AIR."

Octave Chanute wrote that the flight was "the most daring feat ever attempted" and Alexander (Continued on page 147)

American Unknown to Fame First Man to Leave Earth on Wings

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Graham Bell maintained that "all subsequent attempts in aviation must begin with the Montgomery machine." The exhibition had been an unqualified success. Montgomery's eighty-year-old mother had journeyed from Otay to see her son prove to doubters that his machine, which contained less than $20 worth of materials, could navigate the air.

To the experimenter, the show was only a means to an end. He set out, the next year, on a "barnstorming" tour with balloons and gliders, giving exhibitions at country fairs to raise money enough to carry on his work. During the year he used five hot-air balloons and one gas bag, five or six gliders, and three riders. A training station was established to instruct the reckless parachute men in flying the machines. These daring jumpers knew little of the planes they rode, but they were ready to attempt anything.

ONCE Maloney, for instance made a sharp turn at high speed, warping the wings suddenly, and the craft turned a complete side somersault—the first "barrel-roll" of history. Another rider, David Wilke, now residing at Tempe, Ariz., not to be outdone by Maloney, made two side-somersaults, one in either direction. Then he made a steep dive and a long glide and when 500 feet in the air, brought the machine to a sudden stop and settled to earth. After that, Montgomery adjusted the controls to permit only straight flying and gentle turns.

With the money made from the exhibitions, the pioneer was ready to proceed with his work when misfortune engulfed him again. He was planning a flight across the Santa Clara Valley from a point on Mount Hamilton, near the Lick Observatory, 4,000 feet above sea level, when the great earthquake of April 18, 1906, destroyed his workshop and his machines. It was not until 1911 that he was again in a position to resume his work, with sufficient backing to build a powered machine.

On October 31, of that year, he took off on his last flight. He was testing a new glider at Evergreen, Calif. Fifty-four successful hops had been made. In a light breeze above a gentle slope, the craft sailed upward to a height of thirty feet when his assistants saw Montgomery's hands drop from the controls and his body fall limp. It is believed he was attacked by vertigo, to which he was subject.

The unpiloted machine crashed on one wing and Montgomery was hurled through the guy wires, landing on his head. For a time, he appeared to be only slightly injured and talked to his wife and helpers. Then he grew worse and passed away three hours after the accident, just as the doctor, who had been summoned, appeared over the brow of the hill.

ONE of the favorite maxims of Montgomery's fellow pioneer Lilienthal was "To conceive a flying machine is nothing; to build one is little; to fly is everything!" Montgomery, who made a thousand flights, was the first to attain this end. He was "The Father of Gliding."

The comparatively slight recognition given his work is one of the mysteries of aerial history. Possibly because he worked alone and wrote little, he has remained relatively unknown. Today, when wings are common, unstinting recognition should go to this frontier experimenter who led in the conquest of the air.

BUILD IN HASTE, REPENT AT LEISURE

(Continued from page 67)

it until now because, to me, it is the least important part of a residence, although to many persons it ranks first. To me, this part of the house is simply a place to wash clothes, dry them, and for containing a boiler and fuel room. As long as these items are convenient, sanitary, and modern, I can see little difference in the ultimate results obtained, regardless of where the various units are placed.

In the average house, one fourth of the construction cost is represented by the basement. The laundry and heating plant, about the only departments that the basement usually contains, can be placed just as well on the first floor level, and often to advantage from the standpoint of cost and convenience. A basement, however, sometimes possesses the advantage of requiring less ground area.

As to the construction details of my residence, I have followed the most practical and yet economical that I know of. The foundation is hollow tile and brick. The walls above grade are brick veneered on gypsum plaster board and frame. Windows on the lower floor are surrounded by stonework. Metal sash are used throughout the house. The windows are glazed both with plate and health glass. Each window has a roll screen which, of course, need never be removed.

The roof of the house is somewhat unusual. It is covered with copper shingles. That is, each shingle is made of copper. Such a roof need give the house owner no concern for years. Of course, the covering could have been tile, slate, asphalt shingles, or any other good material. The fact that the roof is practically unbroken makes its cost relatively small.

The chimney, in the center of the main portion, measures eighteen by eighteen inches on the inside. I do not believe in using flues smaller than this. If the more common twelve-by-twelve-inch chimney provides a good draft, it is more a matter of luck than design. With the larger size, however, there always is ample draft. Downstairs, in the living room, a wood- or coal-burning fireplace is built into the wall adjacent to the chimney.

Floors are double construction, and even though carpeted, are finished in quarter-sawed oak. This is done in event the floor surface ever is exposed to view; and it is also a more durable construction than the less expensive floors.

Interior walls are all plastered on gypsum plaster board, so as to be free from cracks. Cement plaster is used, and the walls downstairs are given a textured surface, painted and glazed to obtain the desired effect and to make them easy to clean. Upstairs rooms are papered.

Woodwork is waxed walnut, except on the second floor where I have used yellow poplar and enameled it.

This house, which can be called a large residence on a moderate scale, is extremely easy to live in. It can be kept clean without much effort. Such features as the floor tile at the entrance, the easily-cleaned walls, and the simplicity of interior details makes this possible. Furthermore, the building as a whole is more economical than usual with a home of this size, because of the design and construction. The roof will need practically no attention for years to come. The total area that needs periodic painting is almost negligible.

Perhaps a few words about the dining room, or rather dining rooms in general, will not be out of place here. Usually this room is one of the most costly in a house, and at the same time is the least used. My dining room is used less than an hour a day. The breakfast nook takes care of most eating requirements. People still put dining rooms into their homes because it has been done for so many years but the dining room habit may be broken in time, when the waste of good space is fully realized.

If you are going to build, study the problem carefully and decide whether you really need to make a large investment in a room you will use so little. One way of solving the puzzle is to have a combined living and dining room. That is, a room normally used as a living room, but one that can be converted into a dining hall when occasion demands. This is an arrangement that can be met easily when the original plans of the house are made.

The house I have described is so situated that the drive to the garage approaches from the rear. The plan can be employed as well on a lot that makes necessary a front or side approach, if space is available at the rear for turning the car into the garage. Not much room is needed for this purpose with the average size car.

To assure freedom from low water pressure, clogged pipes, and discolored water, brass piping was used throughout the house. Although more expensive than iron, from the viewpoint of first cost, brass is the more economical over a period of years because of the freedom from repairs. Hot water is provided by an instantaneous heater, gas-fired. Wherever the water and waste pipes are concealed between wall surfaces, doors are provided so that access can be had easily in event any changes or repair work is to be carried out as is shown in the picture of my library.

The heating system is of the steam vapor type, with a low-pressure boiler in the basement. Radiators are concealed, which adds to the appearance and at the same time conserves valuable space.

Thermal efficiency is obtained by thorough insulation of walls and roof. The material used for this purpose is cane fiber board. Side walls are double-insulated, a layer of insulation being applied between the brick veneer and the frame, and another layer between the gypsum plaster board base and the frame. The gypsum board itself has an insulating effect, but is not as efficient as the fiber board which is applied beneath the gypsum on the third floor ceiling, and beneath the roof thus affording adequate insulation at the most vulnerable points.

The three-wire system of electric wiring, now standard in Ohio, is used throughout. All wires are contained in flexible, armored conduit.

I estimate the average cost of the house at around $15,000. Of course, this will vary somewhat with locality, but it ought not be much greater, because building costs in Akron are as high as anywhere. It cost me forty-two cents per cubic foot, making the total somewhat more than $15,000. But since it was built, material and labor costs have dropped so that, today, the per cubic foot rate in Akron could be as low as thirty-two cents, making the total cost approximately $13,500. This low rate is regarded as temporary, and undoubtedly will increase after a time. With the employment of cheaper parts and materials the cost of the house, of course, could be reduced appreciably—probably as much as ten cents a cubic foot.

WE HAVE FOUND A WAY TO END MISSISSIPPI FLOODS

(Continued from page 47)

see what has happened. There had been a large hole thirty feet below the top of the levee. Nineteen times out of twenty, the levee would have topped. This time, instead it plugged its own leak by falling into the hole.

One popular fallacy is that when a levee breaks, a solid wall of water, many feet high, rushes across country at express-train speed and overwhelms people in their homes. Actually, as water surges through a levee break, it spreads fanwise. Immediately it slows down and by the time it has gone fifty miles it is advancing at only a mile an hour. There is plenty of time to warn inhabitants of the inundated area. The only reason some are drowned is because they refuse to believe *their* homes will be flooded.

SOMETIMES levees fail because rising waters undermine the foundation and cause the levee to cave into the river—even before they reach the top of the levee. That is the reason why the levee must not be too near the bank. When we need earth to build up a levee, we must be careful not to dig for it right in front of the levee site. In that case, when the river rose, the levee foundation might be attacked, causing the levee to fail.

Levee building is expensive now because of the long haul we have to make for earth. The men who built the smaller levees did not have to go so far for material because they needed less, and therefore could take it from nearer the levee without endangering its [illegible].

To move dirt [illegible] or more to the levee requires tremendous equipment. Big "drag line" machines, which look something like steam shovels but swing their buckets on cables instead of solid arms, do the work. The largest of them pick up six to eight cubic yards at once. So long are their booms that they can fill a bucket with earth and deposit it 320 feet away. Important new auxiliaries to these machines are caterpillar tractors that wallow through seemingly impassable spots with five, ten, or even fifteen cubic yards of soil. Little drag-line machines with about thirty-five-foot booms load them one cubic yard at a scoop.

The season for this work starts in mid-July and ends about the middle of December. High water and rains stop the work. But the hydraulic method can be used all the year around. This has been done successfully along the lower part of the river.

FOR this method, walls are built at the front and back of the levee site, and a mixture of water and earth is pumped through a pipe from the river side into the inclosure. The earth settles, and a fill is built up until it tops the walls. Then new walls are built higher, and the process repeated until the levee is as high as desired. An alternative way is to place the original retaining walls at a greater width than the levee, and then, after filling, to scoop up the dirt from the sides with machinery and place it on top.

Once the levee is built by either "dry" or "wet" methods, it is not going to stay there unless we protect it from the elements and from the river. As heavy rains would cut it to pieces, we "sod" it by planting Bermuda grass. This takes root everywhere and grows rapidly. It binds the soil together and prevents erosion.

Another enemy of the levees is the river itself, which slashes away at its banks. The heavy cutting comes at the sharp bends. It is not exceptional, *(Continued on page 150)*

A WAY TO END MISSISSIPPI FLOODS

(Continued from page 149)

but *average calling*, for the river to eat into the outside curve of a bend at the rate of from fifty to eighty feet yearly! The land does not disappear, for exactly the same amount is added to the opposite bank, in other words, the squirming river is changing its course. We must prevent that, for it would soon undermine and cave in the levees.

That is what "revetments" are for. Revetments are flexible mattresses, of brush or concrete, laid under water to shield the soft banks against the current's action. They extend from the river bottom up the bank to low water level. They must be flexible to take the shape of the uneven river bank.

Imagine a carpet woven of willow brush, two or three hundred feet wide and nearly a quarter of a mile long. That is a typical brush mat used for revetment. A floating factory on a barge moves slowly down the river, weaving and laying the mat as it goes. Stones, in cribs of the mattress, weigh it down to sink it to the bottom.

RECENTLY, an innovation has been perfected and used with success—flexible mats made of reinforced concrete blocks, used for revetments instead of the willow mats. Two sizes of concrete blocks are being used—the smaller size one by three feet and the larger five by eight feet. The blocks are fastened together by wire to make the mattress, which unlike the willow type is laid from the bank out toward the center of the channel.

For further protection, the river bank where the revetment is placed is paved with concrete from the low water level, where the revetment ends, to the top of the bank.

The fact that the Mississippi is one of the kinkiest of rivers, and caves badly at every bend, does not improve the situation. Because of the expense of revetments, I have been asked why we have not cut a channel straight through and entirely remove the bends. Personally, I should like to cut one. But the problem is not as simple as that. The river drops many feet in its long, twisting course around those bends. If we were to cut a channel straight through, we would give the river a much steeper grade and a swifter current. Below the cut-off it probably would attack the bank and rip it away—and then there is no telling where the river would go.

Levees and revetments will keep the river in one place—until a high flood comes along. To provide for that high flood, our plan includes floodways.

NATURAL basins parallel the main river for most of its length. These are the areas which the river, without levees, would periodically overflow. By using levees here and taking advantage of natural walls there we can wall off an area through the basins which Nature has provided and make a floodway or emergency path for the flood waters.

Thus the thirty-mile New Madrid Floodway will divert water from the main river just below Cairo, Ill., when it reaches dangerous heights. The floodway parallels the river and returns the water to it at New Madrid, Mo.

Another projected artificial channel, the 220-mile Boeuf Floodway, begins at Arkansas City and extends southward to the mouth of the Red River. It runs parallel to the main river, through a basin that was formerly overflowed by every moderate flood. In our plan, the Boeuf Floodway should not have to carry flood water oftener than once in about twelve years.

Really a continuation of this channel is the Atchafalaya Floodway of which the Atchafalaya River, natural outlet of Red River, will be a part. This floodway, 120 miles long, empties through the Atchafalaya River directly into the Gulf without returning any of the flood water to the Mississippi. Its levees, fifteen miles apart from one side of the floodway to the other, will confine waters that now for the last eighty miles of the Atchafalaya River have free flow over the entire natural basin thirty to fifty miles wide. When completed, the floodway itself will be used to carry flood water only once in about fourteen years.

Water is diverted at flood times into these floodways by a method unusual in this country but used extensively on the Po River in Italy. At the head of each of the three is what is termed a "Fuse-plug levee," from three to five feet lower than the rest of the levee system. The heights are so chosen that at times of extraordinary floods these levees will be overtopped by water, break, and let the water through into the floodway. Ordinary floods will be carried in the main channel.

Third and last of the key projects in our system of Mississippi flood control is the great controlled floodway at Bonnet Carre, La., which will protect the city of New Orleans, twenty-eight miles downstream. Here a six-mile floodway is being built from the Mississippi to near by Lake Pontchartrain, which empties into the Gulf. At the Mississippi end is a movable dam a mile and a half long—the width of this end of the floodway.

WHEN flood water threatened New Orleans in 1927, it was necessary to dynamite the levee below the city, thus flooding the surrounding country, to save the metropolis. But by the flood season of 1931-1932, by which time we hope to have the Bonnet Carré Floodway ready, we will be able to demonstrate a new way of controlling the flood. Traveling cranes will lift from their places as many as necessary of the wooden "needles" that make up the face of this dam. Through the openings, water from the Mississippi will race along the floodway and pass harmlessly into Lake Pontchartrain. The level of the river will drop, and New Orleans will be safe.

One favorite cure-all flood method for the river is reforestation. That is, planting the upper sections of the Mississippi Valley with trees in the belief that they they will reduce the flow of flood water. I might point out that as long ago as 1844, long before there had been any appreciable deforestation of the Mississippi Valley, the river had a flood which by the St. Louis gage has never been equalled. I am convinced that you might as well try to stop winds blowing from the Gulf of Mexico as try to stop floods by reforestation.

Now that we are sure we are right, we are pushing the work through. A large part of the levee building is already finished, two years from the start of the ten-year program. The New Madrid and the Bonnet Carré Floodways are well under way.

A definite order governs all our activities. First attention goes to the areas bordering the river that are now in critical danger. These points, which include work at Cairo, on the New Madrid Floodway, on the south bank of the Arkansas River, at the upper end of the Yazoo basin, at the Bayou des Glaises Loop, and at the Bonnet Carré Floodway should be completed within three or four years from the date of the flood control plan's adoption.

GREASE AND STAY CLEAN, SAYS GUS

(Continued from page 74)

slow out of a petcock that the service stations don't like 'em. Then there's always the chance that an extra big rock will fly up from the road and knock it off."

"Not much chance of that the way roads are today," Madison scoffed. "I'll take a chance on that, and the time it takes the oil to run out makes no difference to me. Will it be much of a job to fit one?"

"Takes only a couple of minutes," said Gus. "I just run a regular pipe tap into the hole. It cuts out the old threads and makes a new thread that will take a regular petcock. Then I screw in a good bronze petcock that has a spring to keep it tight. Of course you want one that is in the off position when the lever is straight down so it won't jar open."

"How do you figure out what size pipe tap to use?" Madison inquired interestedly.

"THAT'S easy," Gus replied. "Use the biggest pipe tap that will fit in the hole in the oil pan that is just right for the regular quarter-inch pipe tap."

"All right, go to it!" Madison ordered as Gus shot lubricant into the last fitting.

"By the way," he added, "how can you tell whether grease or transmission oil is better to lubricate the chassis bearings?"

"There isn't much choice," Gus replied. "I kind of favor heavy transmission oil in place of ordinary cup grease. Grease, you know, is just oil with something added to make it solid. If the bearing is built so that a bit of flow is needed to get real lubrication, grease doesn't do much good till the friction has made the bearing hot enough to melt the grease. Of course grease stays in better and if the job isn't done often enough, you make out better with grease."

"But if you lubricate often enough so there's no chance of the bearing running dry, you'd recommend transmission oil?" Madison suggested.

"That's my idea of it," Gus replied. "These automatic lubricating outfits that are fitted to some makes of cars all use oil and not very heavy oil at that. But of course it's so easy to push the plunger or step on the pedal of the automatic outfits that you can do it every hundred miles or so."

"THE next car I get is going to have automatic chassis lubrication," Madison stated. "Then I won't have to monkey with a grease gun at all."

Gus smiled. "Sure you will," he said. "None of the automatic systems shoot the oil to every bearing. You have to lubricate some of the important bearings on the steering gear by hand anyhow. Of course the automatic outfits do save a lot of time and they're fine if you don't forget the hand-lubricated bearings."

A short time later Madison was spinning down the road under a bright and cheerful sun.

"I kind of wish I lived in that town," Madison murmured to himself. "Never mind, old bus," he added, patting the steering wheel affectionately, "you won't be bothered with any more dry bearings. I'll see to that myself!"

NEXT month—Gus and Joe solve a queer auto lighting problem—they show you how to get best results from your head lights and to make the stop lights more effective.

You can *see* Ethyl "*knock out that 'knock'*"

A convincing demonstration of how and why Ethyl improves motor car performance. Millions of motorists have learned this through using Ethyl in their own cars.

THIS "knock" demonstration machine, which is shown at state and county fairs and other public gatherings throughout the country, enables you to *see* Ethyl "knock out that 'knock'."

This is made possible by the Midgley Bouncing Pin—a device attached to the demonstration engine which causes a group of lamps on the instrument board to flash every time the "knock" occurs. A wattmeter registers the power being developed and a tachometer shows the R. P. M.s (revolutions per minute) at which the engine is turning over.

In these demonstrations, the engine is run first on ordinary fuel. It "knocks," the lamps flash, you note the position of the needles of the wattmeter and tachometer. Then the valve controlling the fuel is turned and Ethyl replaces the ordinary fuel. The "knock" becomes fainter and dies, the flashes become dimmer and disappear, the engine runs smoothly, quietly. At the same time you *see* that added power is being developed and the R. P. M.s are increasing in proportion.

In terms of your own car this means improved performance through greater power and flexibility, quicker pick-up, less vibration, easier handling and slower depreciation.

Ethyl Gasoline is good gasoline to which leading oil companies are adding Ethyl fluid, the anti-knock compound developed by automotive research to improve motor car performance. Try Ethyl in your car. You will see and feel the difference. It is on sale everywhere at pumps bearing the Ethyl emblem shown below.

Whatever you drive—whatever the oil company's name or brand associated with it—*any* pump bearing the Ethyl emblem represents quality gasoline of high anti-knock rating.

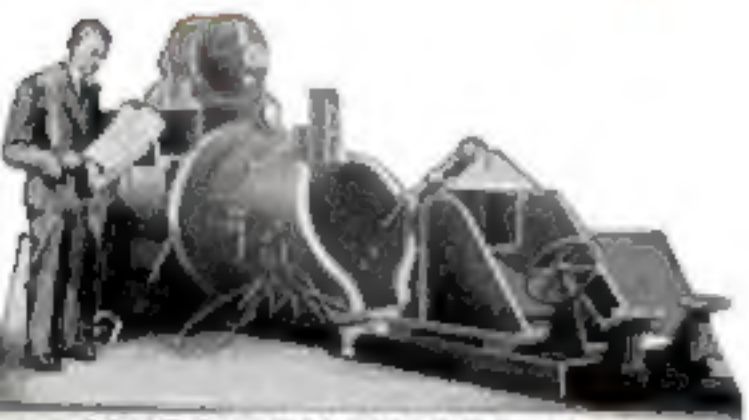
The active ingredient used in Ethyl fluid is lead.

ETHYL GASOLINE CORPORATION, CHRYSLER BUILDING, NEW YORK CITY

ETHYL GASOLINE

NO. 4 OF A SERIES—

THIS series of advertisements is designed to acquaint business men with Grinnell Company as it really is. Automatic Sprinkler protection for which it first won international fame and leadership is not the entire business of the Company. Its equally high reputation for many other industrial piping specialties and commodities has been built on super-standards of manufacture and on original conceptions which are well known to engineers and architects. Businessmen, too, need to know the real quality in these products.



POWER ENGINEER

Special machine for making extra heavy tap joints.

SUPER POWER PIPING

for instance

MANY large manufacturers are finding that the high steam pressures and temperatures of the super power era have made it possible for them to modernize their power plants at huge savings to themselves.

A packing company saves $50,000 a year, for instance. One paper mill will save $220,000 a year. Another $110,000 annually. These savings represent from 25% to 35% on the total cost of modernization.

The transition from low pressure steam to super power has placed a new responsibility on Grinnell Company, one of the country's greatest fabricators of power piping. Processes were evolved, machines were developed, plants were built, men trained, all to fabricate piping to control the increasing power load with new standards of dependability. And, as interpreters of engineering plans for fifty years, we naturally built products with low installation and maintenance costs in mind.

Grinnell lap joints, bends, and welded headers, all bear the stamp of Triple XXX.

Our engineers will advise you on power modernization, without obligation.

The ORGANIZING HAND *prepares for your needs*

Thermolier the copper unit heater. A better and cheaper means of heating many types of industrial and commercial buildings.

Thermoflex Radiator Traps with the famous Hydrox bellows, insuring perfect operation of your steam radiators.

Pipe Fabrication. Pipe bends, welded headers and the Triple **XXX** line for super power work.

Pipe Fittings perfectly threaded, accurately machined and rigidly inspected.

Pipe Hangers featuring easy adjustability after the piping is up.

Humidification Equipment. Complete systems employing the unique automatic control, Amco.

Automatic Sprinkler Systems with the famous Quartz bulb head. The world's largest sprinkler manufacturer and contractor.

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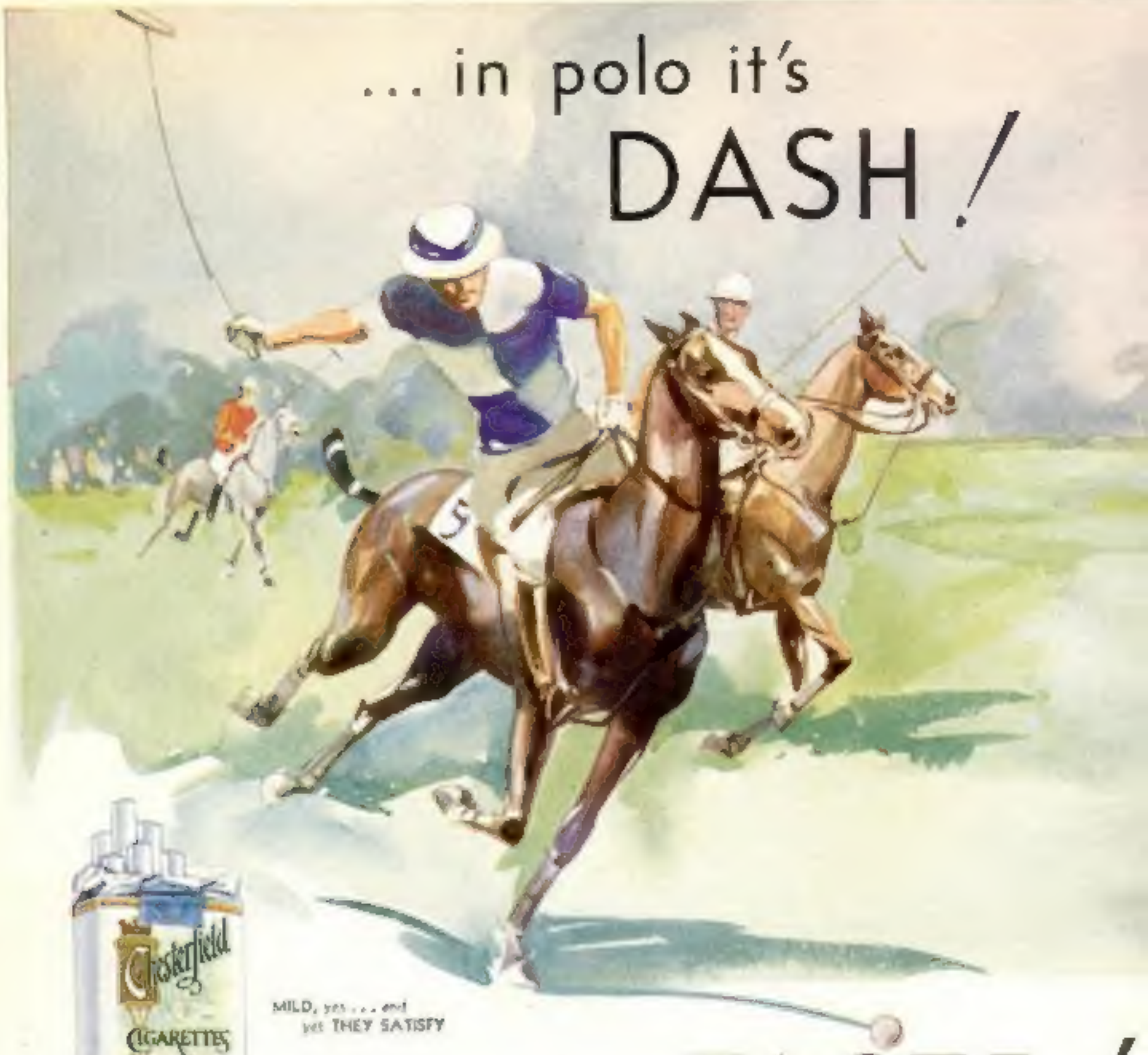

MILD, yet . . . and
yet THEY SATISFY

... in a cigarette it's TASTE!

PONIES marvelously trained, fast, sure-footed; daring riders, skilful play—what group of sport lovers can resist the combination?

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Without one hint of harshness or "heaviness," Chesterfield offers you *taste* in full measure—

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Chesterfield

SUCH POPULARITY MUST BE DESERVED